IMPROVED
HIPOWER

Make Your Track Safer With

## IMPROVED HIPOWERS

The High Pressure Spring Washer

Their great spring power compensates for the slightest loosening of joint bars.

THE NATIONAL LOCK WASHER COMPANY
Newark, New Jersey, U. S. A.

# Frogs, switches and main line

## *a spring washer design for each*

MAINTENANCE of way inspections on spurs and sidings are infrequent, and perhaps cost less than for main line . . . but any costs on secondary track that can be still further reduced offer an opportunity to increase profits.

Thousands of miles of track joints are equipped with standard HY-CROME spring washers. Many maintenance of way engineers know that the permanent reactive pressure of HY-CROME over a wide range automatically compensates for wear and stretch in the bolted parts of rail joints. On siding or main line, HY-CROME makes maintenance inspections less frequent and replacements unnecessary. HY-CROME maintains rail joint rigidity at the lowest cost per mile of any method known. A HY-CROME TRACK TEST will prove it.

THE
RELIANCE MANUFACTURING CO.
MASSILLON, OHIO
Engineering Materials, Ltd., McGill Bldg.
Montreal, Quebec, Canada

HY-CROME
Reg. U. S. Pat. Office


RAILWAY ENGINEERING AND MAINTENANCE
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Alphabetical Index to Advertisers, Page 184 Classified Index to Advertisers, 180-182

# MONEY SAVING TIE PLATES

# FOR 1931 ECONOMY BUDGETS

IN THIS age of tie conservation, the Lundie Tie Plate is, without doubt, a necessity. It costs less to use than to do without. The Lundie Plate is a proven economic device which pays for itself over and over again by protecting ties against mechanical wear and prolonging their life in track. These economies are not limited to the year of purchase but extend through all future years. The economies keep on multiplying.

The outstanding Lundie feature is the design of the bottom. The complete elimination of sharp tie destroying projections assures 100 per cent service from treated ties.

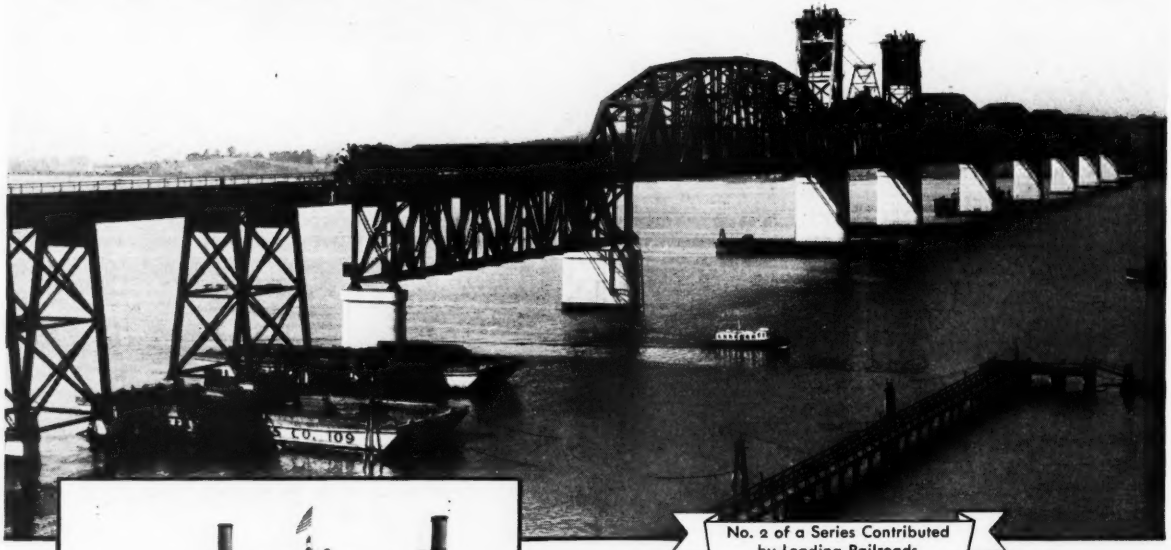
Be sure to specify the Lundie Tie Plate in your 1931 budget.

**The Lundie Engineering Corp.**
285 Madison Avenue, New York
59 East Van Buren Street, Chicago

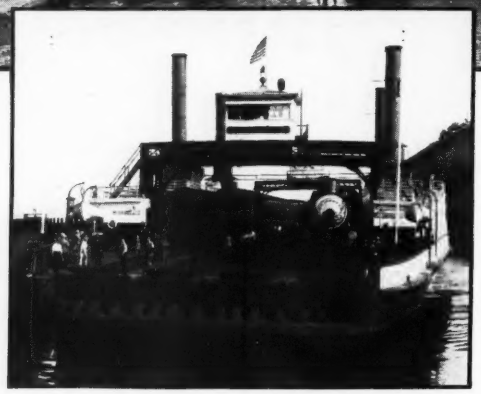
**LUNDIE TIE PLATE**

# World's Strongest Bridge

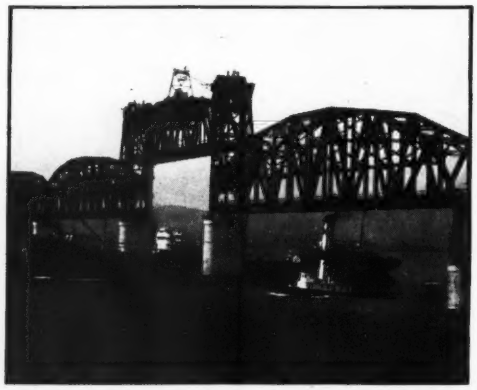
## *Replaces World's Largest Ferry*



No. 2 of a Series Contributed by Leading Railroads



The *Contra Costa*, sister-ship to the *Solano* built in 1879, was for years a spectacular part of western travel.



The electrical lift-span can be raised in 85 seconds to 135 feet above water level, permitting passage of 95% of water traffic.

## The Martinez-Benicia Bridge

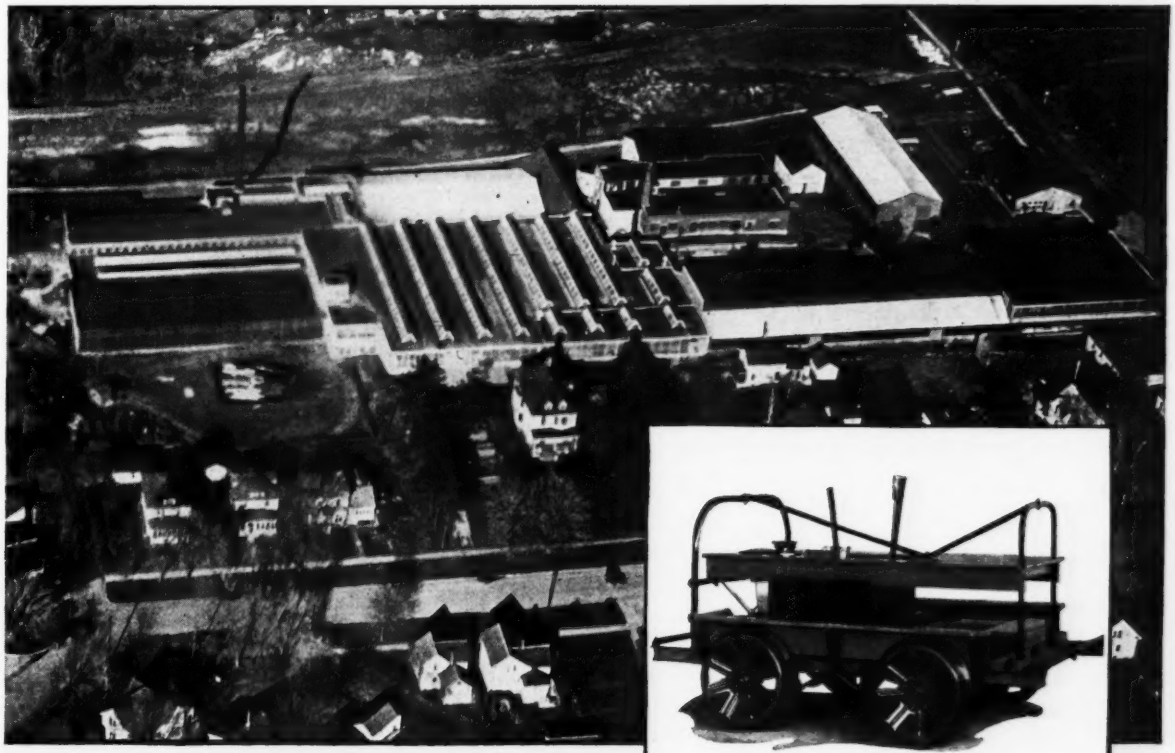
***Erected by the Southern Pacific***

To save passengers thirty minutes and shippers two to four hours—the Southern Pacific Company has just completed the largest and heaviest bridge west of the Mississippi, with loading capacity unsurpassed in the world. A construction project involving a cost of over $12,000,000.

This great double-track bridge eliminates the last physical barrier hindering entrance into San Francisco—the Suisun Bay. Since 1879 the Southern Pacific had wrestled with the complications of treacherous bay bottom, great depth, and ten-foot tide fluctuations. As an early alternative a ferry was built—the huge *Solano*, capable of carrying two whole trains. It was a sensation in its day.

After eighteen months that brought into play every ingenuity of engineering science, the Suisun Bay was finally spanned—a bridge that will ever exemplify the foresight and steadfast courage so characteristic of Southern Pacific management.

**THE RAILROAD WORLD**



Fairmont S2—Aluminum Frame Section Car

Weight 875 pounds. 6-11 H. P. A new idea in motor car engineering taken from airplane construction—lighter in weight, yet equal in strength to steel construction.

# Fairmont Announces—

## *The World's Largest Plant Devoted to the Manufacture of Railway Motor Cars!*

Simultaneous with the dedication of the Martinez-Benicia Bridge, Nov. 1st, Fairmont moved into new quarters, erected at a cost of $200,000. This new daylight plant increases by 45% the floor area for the manufacture of Fairmont Railway Cars.

Naturally we are proud of this new expansion; but, more than that, it gives us new opportunities to serve in research and production—to lower even further the "Over-all Cost" record which has resulted in over half the cars now in service being Fairmont products.

Make use of our research and service facilities for lowering operating costs.

FAIRMONT RAILWAY MOTORS, INC., FAIRMONT, MINNESOTA, U.S.A.

*General Sales Offices:*
1356 Railway Exchange Bldg.,
CHICAGO

*District Sales Offices:*
New York City — Washington, D. C.
St. Louis — San Francisco
New Orleans
FAIRMONT RAILWAY MOTORS, Ltd.,
Toronto, Canada

*Foreign Representative:*
THE BALDWIN LOCOMOTIVE WORKS

Fairmont Mudge
Performance on the Job Counts

**Manufacturers of section motor cars**
**Inspection motor cars**
**Gang and power cars**
**Weed burners — Ballast discers**
**Mowers**
**Ball and roller bearing engines**
**Push cars and trailers**
**Roller axle bearings — Wheels**
**Axles and safety appliances**

**K N O W S  F A I R M O N T**

# WHERE RED SIGNALS SAFETY . . .

JUST as the coastwise skipper breathes more easily when he "picks up" the oscillations of a charted beacon, so does the maintenance man feel more secure when he sees that his iron and steel structures have their protective coatings of pure red-lead.

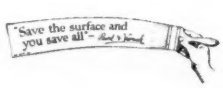
For engineers and maintenance men in all fields have learned that pure red-lead defeats the destructive forces that bear the names of weather, corrosion, rust.

Dutch Boy Red-Lead is a fine, uniform, highly oxidized pigment that furnishes an elastic, durable coating that sticks tight—that protects completely—that wears long.

You can buy Dutch Boy Red-Lead in either paste or liquid form. The paste—Red-Lead-in-oil—is easily thinned to brushing consistency. It comes in the natural orange-red and it can be shaded to darker colors. Dutch Boy Liquid Red-Lead is supplied in six colors—orange-red, two shades each of green and brown...and black.

We invite you to consult our Department of Technical Paint Service about your metal painting problems. Also, ask our nearest branch for helpful booklet—"Structural Metal Painting".






# DUTCH BOY RED-LEAD

## NATIONAL LEAD COMPANY

New York, 111 Broadway—Buffalo, 116 Oak St.—Chicago, 900 W. 18th St.—Cincinnati, 659 Freeman Ave.—Cleveland, 820 West Superior Ave.—St. Louis, 722 Chestnut Street—San Francisco, 2240 24th Street—Boston, National-Boston Lead Company, 800 Albany Street—Pittsburgh, National Lead & Oil Company of Pa., 316 Fourth Avenue—Philadelphia, John T. Lewis & Bros. Co., Widener Building.

# On Crutch— or crawler?

WILL your next shovel, crane or dragline limp around the curves with power on only one crawler, or will it be a Northwest?

The Northwest patented crawler base maintains *full power* on both crawlers even while turning. It is this greater tractive power that enables it to negotiate the roughest terrain, climb out of narrow ditches, cross rails regardless of its position, and travel up ramps or from car to car without danger.

A machine that won't go where you want it won't earn profits.

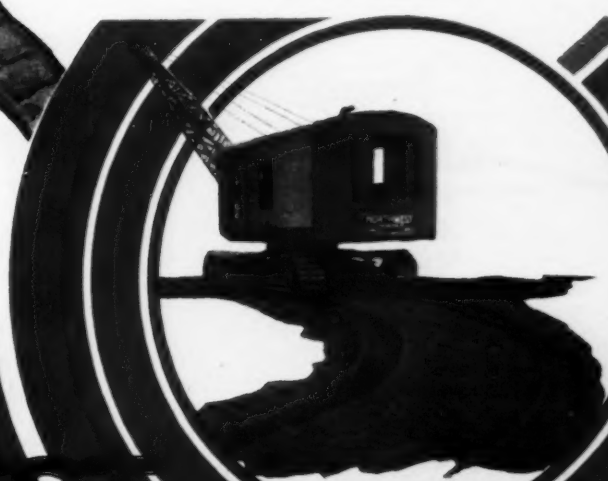
Let us tell you more about it!

## Northwest Engineering Company

*The world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines*

1713 Steger Building 28 East Jackson Boulevard
Chicago, Ill., U. S. A.

*It's not a question of a long or short curve. It's a question of traction and the tread trail of the Northwest simply illustrates that it walks with both feet.*



NORTHWEST

Spike Pullers used with tool carrier.

*Another—*

# Ingersoll-Rand

# Labor-Aiding Appliance for Rail-Laying Operations

Below:—Tool Carrier in closed position.

At Bottom:—Tool Carrier extended to maximum length (31 ft.)

## The Overhead Tool Carrier

***for use with Tie Tamper Compressors***

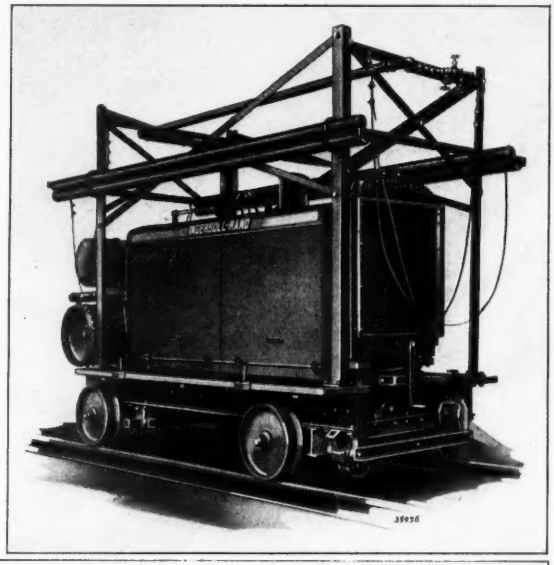
It relieves the men of the weight of the tools and speeds up the work. It is especially suitable for use with pneumatic spike pullers and spike drivers, and eliminates the necessity of working the men in relays.

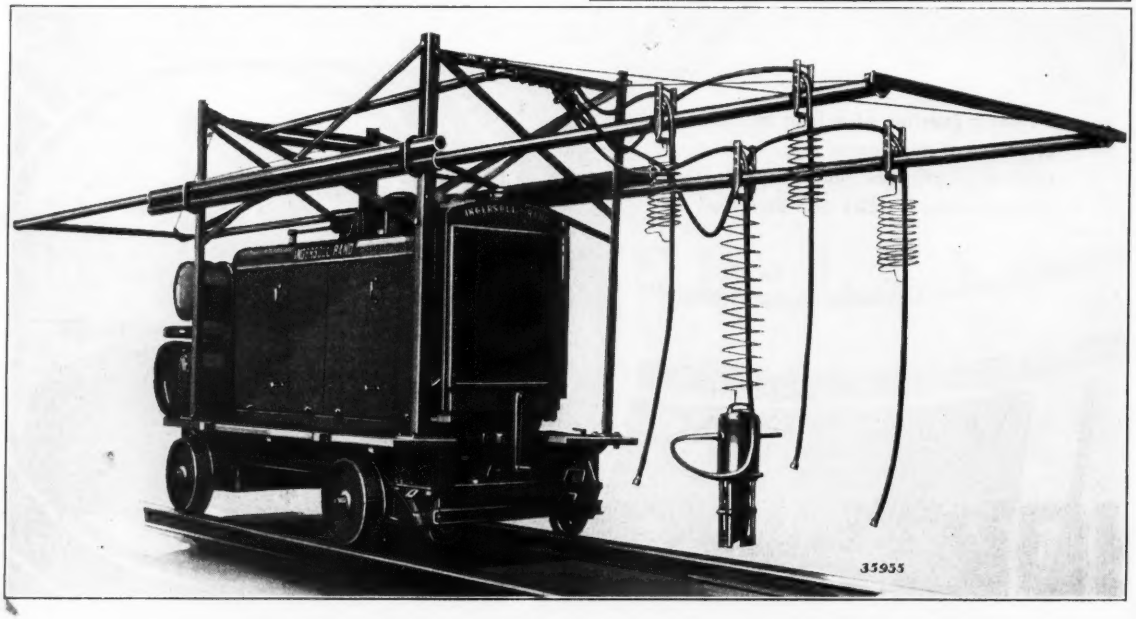
It can be applied to any size 7″ x 6″, 9″ x 8″, or 10″ x 8″ Ingersoll-Rand Tie Tamper Compressor. Ask for complete information.

**INGERSOLL-RAND COMPANY 11 Broadway New York City**

Branches or distributors in principal cities the world over. For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec.

286—TT



# KREOLITE

*Aerial View of Part of the Toledo Plant of The Jennison-Wright Company*

## Framing of Timbers "BEFORE" Treatment Is Essential

By the installation of the latest and most modern framing and boring machinery, we assure the purchaser of timbers most accurately framed at lowest cost.

The life of treated timber depends upon the character of the preservative used. ***We distill our own Creosote oil.*** By so doing it is possible for us to insure to the purchaser a uniform pure product of any grade desired.

Enormous stocks of Railroad Cross and Switch Ties, Structural Timbers and Piling, in all sizes, of Solid Oak or Pine, properly sticked and air seasoned before treatment, available for prompt shipment from Toledo, Ohio, or our Midland Creosoting Company plant, at Granite City, Ill. (East St. Louis).

**THE JENNISON-WRIGHT COMPANY, TOLEDO, OHIO**
**Branches in All Large Cities**

# R.R. TIES

# Clean your Ditches and Cuts *this Spring*

With the same machine that saves time and labor all summer as a crane on general pick-up and work train service — a Bucyrus-Erie convertible gas excavator.

A quick change of front end equipment converts the machine from a crane, clamshell or dragline to a powerful shovel—for widening cuts, grading for new trackage, loading gravel and ballast in the pit, and doing other digging jobs anywhere on the road.

Built to work in restricted clearances, designed to ride a railroad car without any dismantling — Bucyrus-Eries have won popularity wherever equipment is used on a merciless basis of rock-bottom performance costs.

A Bucyrus-Erie can cut your maintenance costs from one end of the line to the other. Let us supply you with the facts.

BUCYRUS-ERIE COMPANY, South Milwaukee, Wisconsin
Offices or distributors in principal cities

A-239—2-31—REM

BUCYRUS ERIE

# NEW STEEL DEMANDS THIS TELEWELD PROTECTION

## Every Day At The Chicago N.R.A.A. Show TELEWELD Will Demonstrate This Service

TELEWELD'S Slotting Tool for conditioning new steel prevents end-chipping by slotting and beveling rail ends after new rail has been cold rolled under traffic. ◆ See it at the Chicago Show.

Teleweld rebuilds worn and badly battered rail ends. Teleweld also has a proven process of frog and switch reclamation which obviates the necessity of replacement. Learn the true facts regarding the application of the Teleweld processes by attending the Teleweld booth at the Chicago show. A Teleweld welder will build up battered steel to as good as new condition while you look on.

Then you will better understand why 25 class I railroads with a combined total of 100,000 miles of track have already used the TELEWELD processes.

*Rail End Restoration Slotting New Rail Frog and Switch Reclamation ◆ Steel Bridge Reinforcement*

TELEWELD
A MILE AT A TIME

ELECTRIC RAILWELD SALES CORPORATION
RAILWAY EXCHANGE BUILDING, CHICAGO

*Booth numbers 222-223-224 at the Chicago N. R. A. A. Show March 9th to 13th inclusive. ◆ (The complete Teleweld service will be demonstrated daily at the above booths.)*

# A CRANE FOR EVERY HANDLING NEED

THE best locomotive and crawler cranes are not built to meet a price—but rather to meet their users' most exacting demands.

Because Industrial Brownhoist builds its cranes the latter way, there are thousands more of them in service than any other make.

Industrial Brownhoist Corporation, General Offices, Cleveland, Ohio

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, San Francisco, New Orleans

Plants: Brownhoist Division, Cleveland, Ohio; Industrial Division, Bay City, Michigan; Elyria Foundry Division, Elyria, Ohio

INDUSTRIAL BROWNHOIST

# ARMCO'S

## *Newest,* proved Contribution to More enduring Safe drainage

*Armco Paved Invert (triple paved) Pipe installed by the Armco threading method under a railroad in Georgia.*

## *Being widely adopted by railroads*

THEIR OWN TESTS have proved to railroads that Armco Paved Invert Pipe possesses greater durability. And therefore increased safety—at lower cost per year. Five years of use of this remarkable Armco creation show that the paved invert principle is more than an important step ahead . . . That it actually solves to a marked extent the ages-old problem of culvert destruction by erosion.

Armco Paved Invert Pipe is paved where the wear comes — in the invert. Its basic structure of Armco Corrugated Iron Pipe (with an unequalled record of 25 years service to date) is paved with a tough bituminous material which effectively resists the wear of silt, sand, stones, and even boulders.

Evidences of its success are widespread, for railroads in increasing number are adopting Armco Paved Invert Pipe as standard construction. A check up of per-year costs of various types and kinds of culverts will reveal the added safety-economy factors present in this exclusive Armco product. Armco engineers throughout the country are at your service. Address the Association for factual data.

*Armco culverts and drains are manufactured from the Armco Ingot Iron of the American Rolling Mill Company and always bear its brand.*

ARMCO CULVERT MANUFACTURERS ASSOCIATION, *Middleton, Ohio*

ARMCO
*Paved Invert*
PIPE

C,1931,ACMA

# *New Rails Deserve Machine-Adzed Seats!*

When relaying rail it is almost impossible to secure a job of hand adzing that will assure rail seats on all ties being in the same plane. Naturally, under traffic, the rails must tip in or out, to reach a solid bearing. This damages the new rail by setting up torsional strains and throws the track out of gauge and line.

With Nordberg Adzing Machines, however, every rail seat must come to the same plane. Torsional strains are an impossibility and the relayed track positively holds its gauge and line. Machine adzed ties will result in better track, longer rail life and reduced maintenance expense.

## Nordberg Track Machines

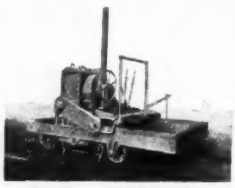
The machines shown on this page were developed to solve your problems. They have proven their ability to impressively speed up track maintenance work, cut its cost and improve standards.

Let them help you catch up with deferred work this year—at a big saving over hand methods.

NORDBERG MFG. CO.
Milwaukee, Wis.

NORDBERG

Nordberg Power Rail Drill


Nordberg Track Shifter

Nordberg Power Track Jack

Nordberg Power Spike Puller

# These Retaining Wall Advantages Especially Important--*Now!*

### *Lower Cost*

When you build your walls of *precast cribbing*, you save the cost of all form work required for a poured wall—the cost of stripping and rubbing the face—of expensive foundations—save on salvage value if the wall is moved.

When building with *Federal 2-Piece Cribbing*, you save on the cost of material and labor to handle three or more units—also maintenance cost, because of the *closed face.*

Showing the splendid closed face of a Federal Retaining Wall. It resembles fine masonry in appearance.

### *Build in Winter*

Cold and snow are no bar, because Federal units are factory made and cured, brought to the site and unloaded direct from cars to wall.

Send for booklet describing this strong, stable construction and showing the many Federal walls in use by the country's leading railroads over a period of years.

FEDERAL-AMERICAN CEMENT TILE CO.

*Executive Offices:* 608 South Dearborn Street - - - - - Chicago

*Plants Near* CHICAGO - NEW YORK - PITTSBURGH - BIRMINGHAM

*Concrete Products* *for Over 25 Years*

FEDERAL 2piece Concrete CRIBBING

# "Only 45 minutes delay in 5 years"

A COMPLETE LINE ½ to 3½ cu.yds.

THE Davis Construction Co. of Atlanta, Georgia, owns 4 P&H ¾-yd. Clamshell Cranes. C. O. Andrews, operating one of them, writes:

"I want to say that the P & H is, beyond doubt, the best machine of its kind on the market today. For service and economy she can't be beat.

"This machine has been in service for 5 years and according to daily reports it has held up the job only 45 minutes, due to a breakdown, since it was purchased."

Not only do P&H Cranes require minimum maintenance, but they turn out big yardage due to exceptionally fast line and swing speeds. If you are looking for greater yardage at lower cost, get in touch with P&H. Write for bulletins describing P&H "Corduroy" Cranes.

P&H

CORDUROY [CRAWLER] CRANES

HARNISCHFEGER CORPORATION

Established in 1884

4420 W. National Avenue - - Milwaukee, Wisconsin

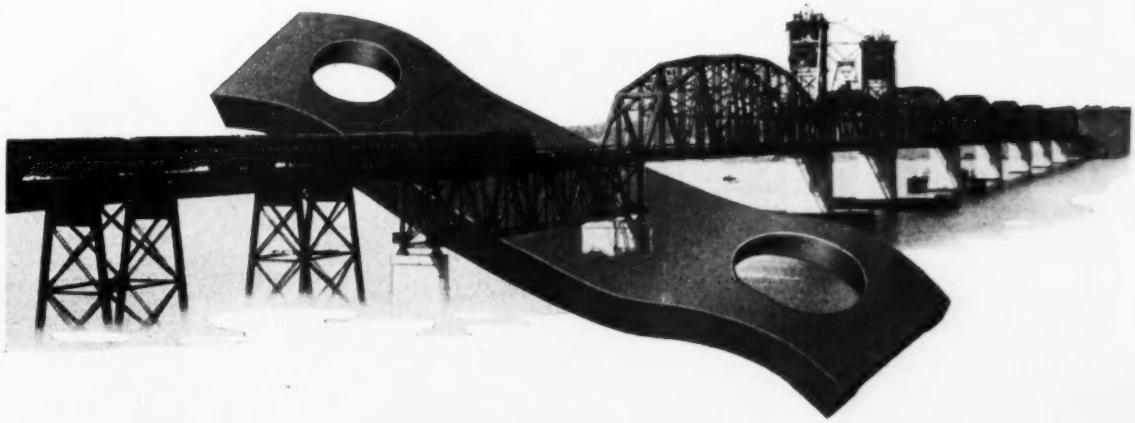
*Offices and Agents in All Principal Cities*

Warehouses and Service Stations:

Hoboken Memphis Jacksonville Seattle Los Angeles San Francisco Dallas

A-5210

# *Southern Pacific Co's New $12,000,000 Bridge*



*equipped with*

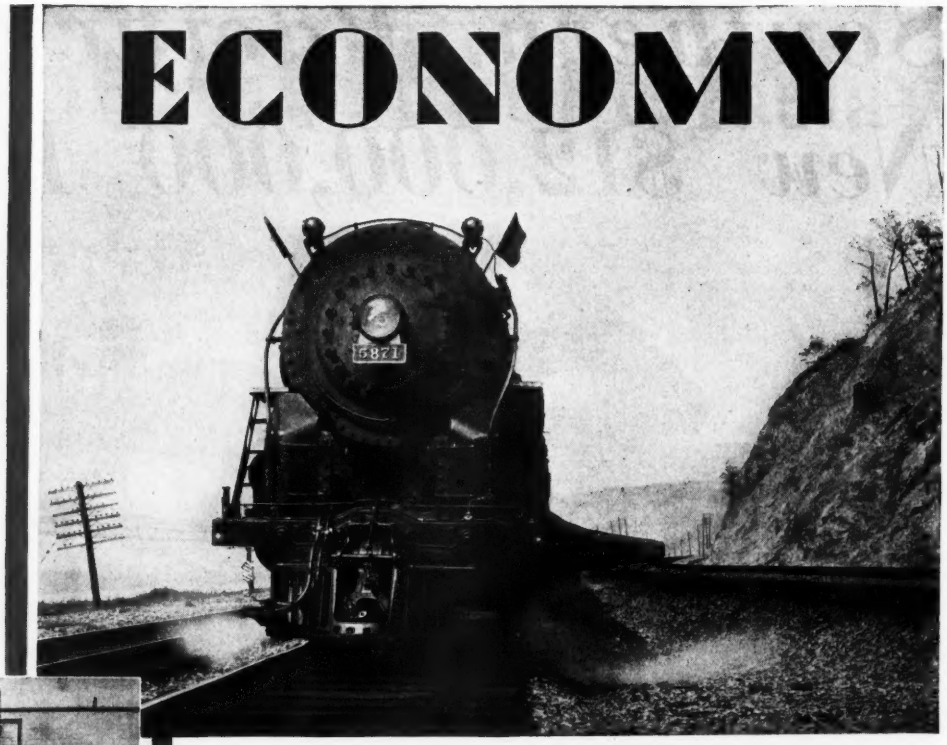
# VERONA RAIL JOINT SPRINGS

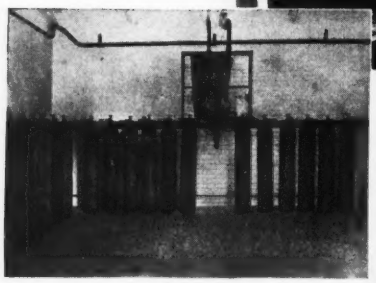
IN order to secure maximum safety at the rail joints, all track bolts are securely held at uniform tension with Verona Rail Joint Springs.

## VERONA TOOL WORKS

Pittsburgh, Pa.

# ECONOMY





*Oxweld Wall Type Oxygen Manifold installed in Oxweld Standard Generator House*

ECONOMICAL generation of acetylene and dependable, waste-proof distribution of oxygen and acetylene for railroad welding and cutting operations are among the salient features of Oxweld Railroad Service. Qualified by years of experience in this work, Oxweld engineers estimate accurately the railroad requirements and furnish and install equipment that has proved most efficient and economical.

Under their supervision, acetylene generators and oxygen manifolds are installed. Oxwelded piping systems are built to insure steady, uninterrupted supplies of gases to points where work is to be done. Handling of gas cylinders is eliminated. No time lost by operator's changing hose and regulators. No interference or delay to other workmen due to cylinders in the way.

Because Oxweld Railroad Service insures maximum economy in oxy-acetylene welding and cutting, the majority of Class I roads contract for it year after year.

OXWELD RAILROAD SERVICE

THE OXWELD RAILROAD SERVICE COMPANY

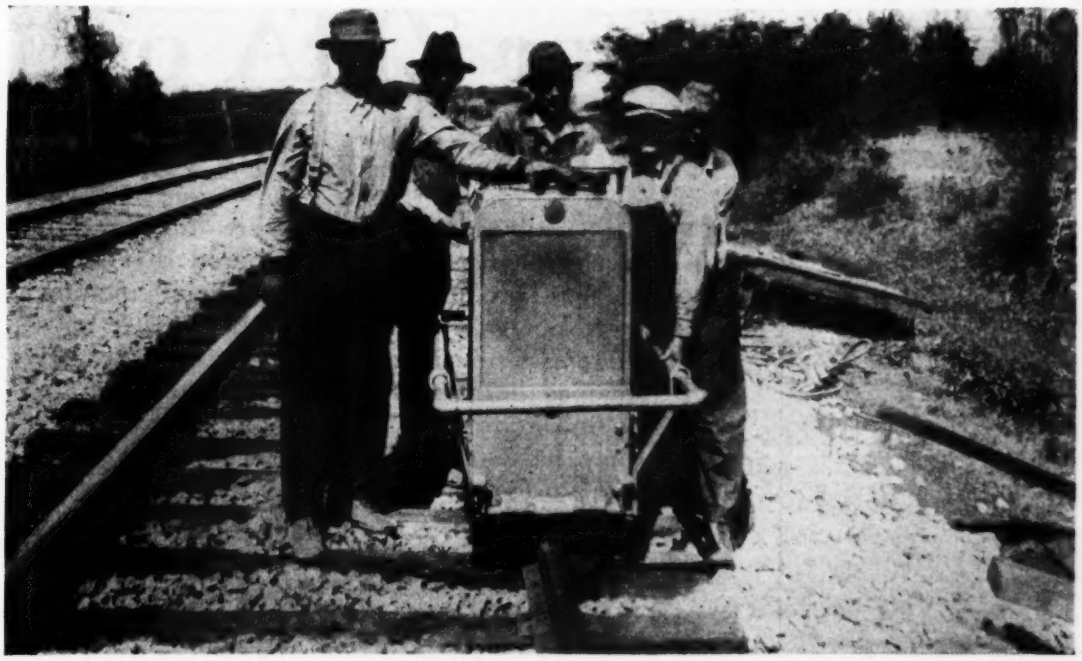
*Unit of Union Carbide and Carbon Corporation*

UCC

NEW YORK
Carbide and Carbon Bldg.

CHICAGO
Carbide and Carbon Bldg.

ELECTRICITY IS THE MODERN POWER



# IDEAL SMALL CREW EQUIPMENT

A small section gang of from 3 to 8 men equipped with

# SYNTRON ELECTRIC TIE TAMPERS

of either the 2-4 or 6 tool units will keep a section in perfect surface, prevent battered rail ends, straighten surface bent rail, tamp tie renewals up tight and keep frogs and switches solid.

**Small, Light, Power Plants - Flexible Cable Lines - Fast, Powerful Tampers Always the Same, Constant Blow Unaffected by Heat or Cold**

Built in 2-, 4-, 6-, 8-, 12-tool outfits.

**SYNTRON CO., PITTSBURGH, PA.**

15 Factory Service Branches

OTHER SYNTRON PRODUCTS

Nut Tighteners
Rail Drills
Screw Spike Drivers
Rail Saws
Rail Millers
Portable Drills
" Saws
" Hammers
" Grinders
Rail Grinders
Flood Lights

# 33 uses for ZMA on one railroad

ZMA

1. Cross Ties
2. Turn Table Ties
3. Switch Ties
4. Fence Posts
5. Signal Posts
6. Signal Trunking
7. Foot-walks
8. Tell-tale Posts
9. Power Poles
10. Cross Arms
11. Telephone Poles
12. Freight Platforms
13. Passenger Platforms
14. Freight House Floors
15. Wharf Timbers
16. Station Floors
17. Coal Trestles
18. Scale Pit Timbers
19. Underpasses
20. Bridge Lumber
21. Mail Cranes
22. Running Boards on Steel Cars
23. Water Towers
24. Crossing Gates
25. Elevator Shafts
26. Sand Houses
27. Section Houses
28. Scale Houses
29. Fire Hose Houses
30. Board Fencing
31. Snow Fences
32. Stock Cars
33. Refrigerator Cars

WHILE railroads have been the largest users of treated forest products, it is significant to note a recent survey on one eastern railroad.

It developed the interesting fact that since starting to use ZMA they have found 33 *additional* uses for ZMA Pressure-Treated Lumber distributed throughout all operating and maintenance departments.

Every railroad in the United States and Canada has almost identical uses for ZMA for longer life and greater economy.

*Our engineers will be glad to give further information and cooperation*

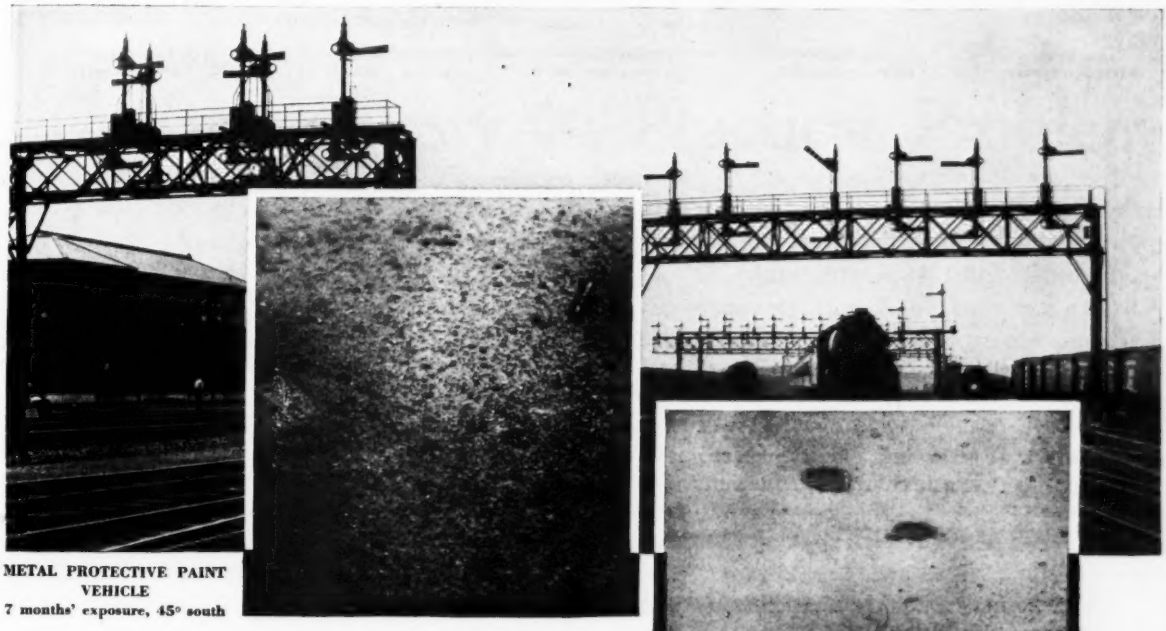
## CURTIN-HOWE *Corporation*

TIMBER PRESERVATION ENGINEERS
415 LEXINGTON AVENUE, NEW YORK CITY

Tennessee Electric Power Building, *Chattanooga, Tenn.* 20 North Wacker Drive, *Chicago, Ill.*
Security Building, *Minneapolis, Minn.*

Curtin-Howe Corporation, Ltd., *McGill Bldg., Montreal, Can.* American Smelting & Refining Co., *General Agents, Mexico City*

# Du Pont DULUX
## *cuts upkeep costs on all equipment*



METAL PROTECTIVE PAINT VEHICLE
7 months' exposure, 45° south

***Field-tested over three-year period.*** **DULUX** ***has proved its ability to retain color, gloss, and protective film at least*** **50% to 100%** **longer** ***than paints, varnishes and enamels***

**An amazing chemical development ... the greatest since DUCO**

**DULUX VEHICLE—19 months' exposure 45° south**

More than 175% longer life for Dulux! The 45° southern exposure is twice as severe as ordinary exposure. To insure shorter and more accurate tests, each of these steel panels was given a single coat of the clear vehicle without rust-inhibitive pigments.

THERE is hardly a surface on the road on which you cannot cut your maintenance cost with an entirely new type of finish—Dulux. Bridges ... towers ... structural steel ... stations ... rolling stock, all property can be improved in appearance, protected more completely, yet refinished less frequently. Signs will be more attractive, semaphores more visible, with Dulux.

Dulux was developed several years ago by du Pont chemists. But it was secretly guarded until it was perfected, tested, retested, and approved in actual service on railway structures and equipment. Side by side with the best orthodox finishes, Dulux was checked for its resistance to every conceivable condition. Dulux-finished metals were immersed in brine, sprayed with salt solutions, exposed to sun, rain, heat, cold, and sulphur fumes. In every case, results showed that the life of Dulux is at least 50% to 100% longer than the present oil and varnish types of finish. They showed that its retention of color and gloss is also greater by 50% to 100%.

In every property DULUX is a distinctive type of finish —an exclusive chemical development of the du Pont Company ... of one of the finest research and control laboratories in the world.

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Subject: Our New Typography

January 29, 1931

Dear Reader:

"I have just finished reading the January issue of Railway Engineering and Maintenance and am writing you to congratulate you upon the decided improvement in the type which you have introduced in this issue. The new pages are more attractive in appearance and the eye-strain to which the reader is subjected is materially reduced."

In these complimentary terms a reader has indicated his approval of certain changes in typography that we made last month. We hope that he speaks for our large circle of subscribers.

Possibly some of you wonder why a paper changes its typography. It may never have occurred to you that styles change here as in dress, furniture, automobiles, etc. The face which we have selected for our headings, known as Kabel bold, is a modern adaptation of the familiar Gothic type that has come into widespread use within recent months. It indicates the current trend from the shaded letter of the Caslon and allied type families to the sans serif letter of uniform weight. It was selected for Railway Engineering and Maintenance to give the paper a masculine effect, characteristic of the men of action who comprise our circle of readers.

Current trends have also been followed in providing more white space around headings for articles, around illustrations, etc. In the contents page, the news pages, etc., the same attempt has been made to present a more attractive and more easily readable paper. In short, while exerting every effort to maintain and to raise the standard of the material published, we have also endeavored to make it easier to read.

You are the judge of the success of our efforts. We hope that your verdict is favorable.

Yours truly,

Elmer T. Howson

ETH*JC

Editor.

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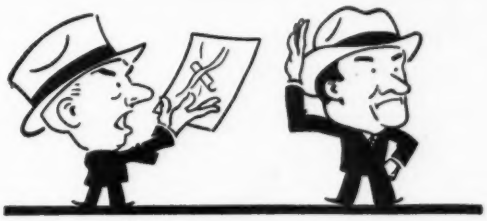

# Culvert Theory vs. Practical Problems

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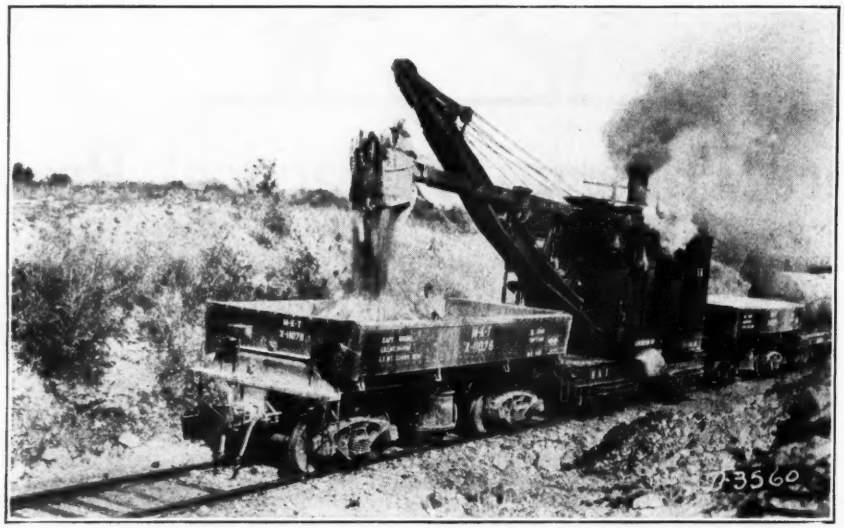

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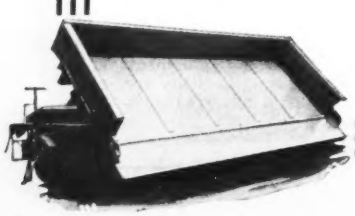

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# Railway Engineering and Maintenance

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*"These two* stops *to operate switch before and after ends of double track are eliminated by the 3-in-1 Switch Stand."*

# Stops

## AT THE ENDS OF DOUBLE TRACK

# COST MILLIONS ANNUALLY

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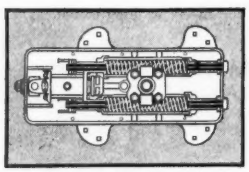
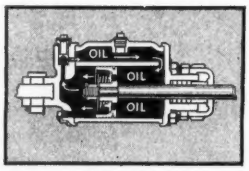


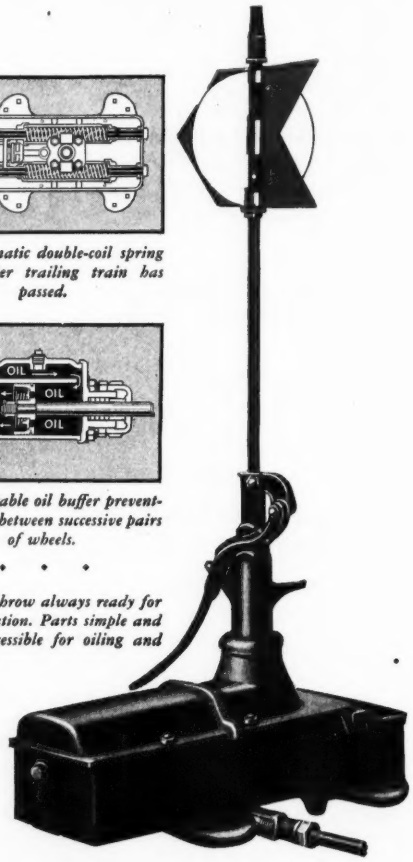
*The automatic double-coil spring return after trailing train has passed.*




*The adjustable oil buffer preventing return between successive pairs of wheels.*

* * *

*The rigid-throw always ready for hand operation. Parts simple and readily accessible for oiling and inspection.*



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Railway Engineering and Maintenance

# TIME TO FIGHT

## Unfair Competition Cuts Railway Employment

IN November, 1930, the last month for which figures are available, the Class I railways of the United States employed 107,155 less men in the maintenance of their tracks and structures than in the corresponding month of the previous year. In other words, the number of men employed in this department of railway service was reduced more than 26 per cent in a single year, and this decline still prevails.

In part, this decrease in employment is due, of course, to the recession in business that has been evident in all industry. It has been influenced also by the steadily increasing use of mechanical equipment. It is, however, largely the result of a change that has been coming over the railway industry incident to the diversion of a large volume of traffic to other agencies.

Any reduction in the business of the railways, of course, reduces the number of men required for its transportation. It likewise reduces the wear and tear on the property and the number of men required to make it good. That loss of traffic, rather than the replacement of men with machinery, is the primary cause for the present decline in employment is brought out by a survey made by the train-service brotherhoods which shows that more than 46,000 of their members were laid off in the ten months from October, 1929, to July, 1930, as a result of the loss of traffic, as compared with 28,000 laid off from all other causes during the six years immediately preceding.

### The Extent of the Loss

To refer more specifically to the nature and extent of this decline in traffic, attention may first be called to the trend in passenger business. Here the tendency has been steadily downward since 1920 until in 1929, a year of widespread business activity, the total volume had shrunk more than a third, while in 1930 it was less than 60 per cent of that of a decade previous and was smaller than in any year since 1906. Expressed in another way, the railways have lost $500,000,000 in passenger business in the last 10 years.

In freight traffic the same trend is apparent, although it is as yet evidenced by a decline in the rate of increase rather than by an actual decrease in volume. The effect on railway earnings is none the less serious, however. This decline in freight traffic is shown by the fact that whereas this business increased 86 per cent in the decade from 1890 to 1900, 80 per cent from 1900 to 1910 and 62 per cent from 1910 to 1920, it was actually less in 1930 than in 1920, or, if the last year is considered subnormal, the increase from 1920 to 1929 was only 9 per cent. In other words, the average annual rate of increase in freight traffic declined from 8.6 per cent 30 years ago, to 1 per cent in the 9 years ending with 1929, showing that the railways are now in a period of practically stationary traffic, if not facing an actual decline for the first time in their history.

### The Cause

What is the cause of this trend? Surely it is not that our country has ceased to develop, or that our people are becoming less dependent on transportation. Rather, it is the reflection of the encroachment of other transportation agencies.

Returning again to passenger traffic, much of the loss is attributable to the private automobile, against which there is probably little recourse. However, no small part of the loss in passenger business by the railways is attributable to the motor bus. It is significant that in the period from 1920 to 1929 when railway passenger earnings decreased $414,000,000, the number of buses increased 820 per cent. To be more specific, recent surveys show that motor coaches are carrying nearly four times as many passengers as the railways between such points as Chicago and Indianapolis and between Chicago and St. Louis.

In like manner the motor truck has taken the short haul and is even now beginning to take considerable quantities of long haul freight traffic from the railways. Thus, during the period from 1920 to 1929, when the annual rate of increase in freight traffic was declining so steadily, the number of registered motor trucks increased 236 per cent. That this competition is of far reaching possibilities is shown by the fact that whereas in 1929 less than 50 bales of cotton were moved into New Orleans by truck from points on the Illinois Central, the traffic so handled increased to 7,221 bales in 1930.

### Unfair Competition

The traffic moving by bus and truck is attracted by rates which are made possible only by the subsidy provided by the public in the form of tremendous expenditures for highways which are, when completed, available for the use of motor vehicles without adequate charge, whereas the railways must provide at their own expense

the necessary rights-of-way and terminal facilities. As a part of the public, the railways and railway employees are bearing their full share of the cost of providing these roadways which afford the means of taking traffic and employment away from them.

Equally serious in its possibilities, and still more vicious in its methods is the widespread propaganda for the development of inland waterways to "relieve" the railways of a traffic that they need all too sorely. Here the public is not only providing vast sums to build the waterways which are turned over free of fixed charges or upkeep expense to the barge operators, but the government is itself operating barges thereon in competition with the railways at rates that are possible only by reason of the fact that the taxpayers are not only paying the interest, but also the deficit incurred in operation in most years as well. And the railways and their employees, as taxpayers, are again required to contribute to the support of their competitors.

### A Problem for the Employees

What can be done about this matter? The railways are not and can not be in politics. The individual employee is not bound by such restrictions, however. He has a right—in fact, he owes it to himself and to his family—to select as his representatives in government those men who will best protect his interests.

There are one and one-half million railway employees. With their families, they comprise five million of our people. There are an equal number of persons engaged in the production of locomotives, cars, rails and other materials used by the railways and who are equally dependent for their livelihood on the continued success of the railways. There are probably another million shop-keepers and artisans who gain their livelihood from those employed by the railway and railway supply companies. If this army of nearly fifteen million of our citizens can be made to realize that the conditions confronting the railways are resulting to their personal detriment, they have the means to demand fair play. It is their problem just as much as it is that of the corporations.

That railway employees are awakening to this situation is evident in numerous quarters. At a meeting in St. Louis last October, the Brotherhood of Railway Clerks gave extended consideration to this problem, culminating in the inauguration of a movement to enlist other railway organizations in an effort to secure the enactment of legislation bringing other forms of transportation under the same regulations that are imposed on the railways. The train service brotherhoods have inaugurated similar action, and at its recent convention in Chicago the Brotherhood of Maintenance of Way Employees committed itself to the support of such a program.

Every railway employee, whether a member of a labor organization or not, owes it to himself and his family to fight for fair treatment for the railways and for the regulation of the railways' competitors on a basis comparable with that which has been fixed for the railways themselves. It is only in this way that the unfair handicaps that exist at present can be removed and the roads given an equal chance to secure the traffic that they are best prepared to handle. It is only when they receive their fair share of the traffic, that they can provide employment for the large number of men who have long looked to the railways for employment.

It is time that railway employees, individually and collectively, demand fair treatment for their employers and for themselves. In short, it is time to fight.

## LABOR SUPPLY

### Why Not Recruit Men From Local Communities ?

IT IS a far cry from the labor conditions of prewar and war days to those of today. Before the war, maintenance officers had to deal with the non-English speaking immigrant, his peculiar habits of living and, still worse, the exasperating tactics of the unscrupulous interpreter. During the war, they were glad to secure labor of any kind that could be obtained in the face of the skyrocketing wages paid by war industries. Today the problem is to find places for those employees who have been faithful and loyal in their service to the company.

This change from the status of a labor shortage to that of a surplus is due only in part to the depression that came at the close of 1929; rather it represents the result of a gradual process extending through the years, which has made it possible for the railroads to recruit their maintenance forces more and more from among the residents along these lines. Why not carry this tendency to the logical conclusion and, in so far as possible, restrict employment to men of this class? A force of employees, speaking the same language and reared and schooled under the same environment is more homogeneous, promises more candidates for advancement, and will promote better relations between the railway and the communities along the line.

## THE DROUGHT

### Dry Spell Tests Adequacy of Water Supplies

WHILE the drought of 1930 was a God-send to the track foremen and supervisors who were confronted with the problem of maintaining tracks with reduced forces, its influence was exactly the reverse in respect to the officers of water service. Reduced supplies resulting from a deficiency of rainfall were a serious consequence, although offset in part by a lessened demand resulting from decreased traffic. However, in some sections of the country water shortage imposed a most severe burden on the water-service men, and in certain territories the situation is still critical, if not actually more acute than it was during the past summer.

This last fact is a significant one in that it indicates the unusual duration of the drought and has an important bearing on future water-supply studies. Lack of adequate supply during a severe drought may be ascribed to any one of several underlying causes. It may indicate that the supply was developed without adequate con-

sideration of rainfall records of past years. It may be due to the fact that the expenditures necessary to provide an adequate supply during occasional periods of extreme drought could not be justified, or it may be that in certain territories the present drought has exceeded any other drought of record.

If the last explanation is the correct one, then it is highly important that every possible bit of information as to rainfall, stream flow, water stages, etc., be made a matter of permanent record, because such information will be invaluable in future studies of water supplies.

# TOOL HOUSES

### Ideal Location a Real Problem for Study

IN THE readjusting of section limits and the resulting relocating of section headquarters, a step which has been taken so frequently during the last few years to meet changed conditions, many supervisory officers have had it brought clearly to their attention that it is almost impossible to secure ideal locations for tool houses on many sections. Most railway men can think, off-hand, of at least two or three factors which should be taken into consideration when relocating section headquarters, the most important of which would undoubtedly be that they should be located at or near the centers of the sections they serve, but those who have had the actual responsibility for work of this nature on a large scale, and who have studied all phases of the subject, realize that the desirability of having the section tool house near the center of the section is only one of the factors to be taken into consideration.

Altogether, at least a dozen considerations might be mentioned as bearing on this matter. From the standpoint of first cost, the site selected should lend itself readily to adaptation for the standard layout of section grounds without excessive grading; it should be at a point where a clear unobstructed view can be had of the track for some distance in both directions; in double-track territory, it should be located beside the track over which the supply train is operated so as not to cause extra work in the handling of materials and delays by the operation of trains on an intermediate track; and it might well be at or near a telegraph office, not only because of the greater accessibility of the section forces in cases of emergency, but also because of the lesser likelihood of theft in such a location. In no case should it be permitted to cause an obstruction to the view of train crews, to telegraph operators if near a telegraph station, or to the public if near a road crossing. In addition to these considerations, it is desirable that the section headquarters be located as near a town as possible, where labor can be secured readily, and where the men in the regular forces can find suitable living accommodations for themselves and their families and schools for their children. A number of other considerations might be mentioned, such as proximity to a good drinking-water supply, and to grounds suitable for company section dwellings, etc., but these will suffice to indicate the many factors which should be taken into consideration when relocating section headquarters if the most desirable sites are to be selected.

To meet all of these conditions on all sections is practically impossible; it may also be impossible to meet most of them on a large number of sections. However, the fact remains that if greater weight and consideration are given to all of these factors when making changes in section headquarters it will result in more satisfactory, all-around locations from the standpoints of the men and of the railroad than otherwise would be the case. Changes in the locations of section headquarters generally involve considerable expense and are infrequent, often lagging far behind changes in influencing circumstances and conditions which would warrant them. For this reason, as well as by reason of the greater efficiency gained by the selection of the most advantageous headquarter sites, the subject of new locations should be given the most careful study.

# VIADUCTS

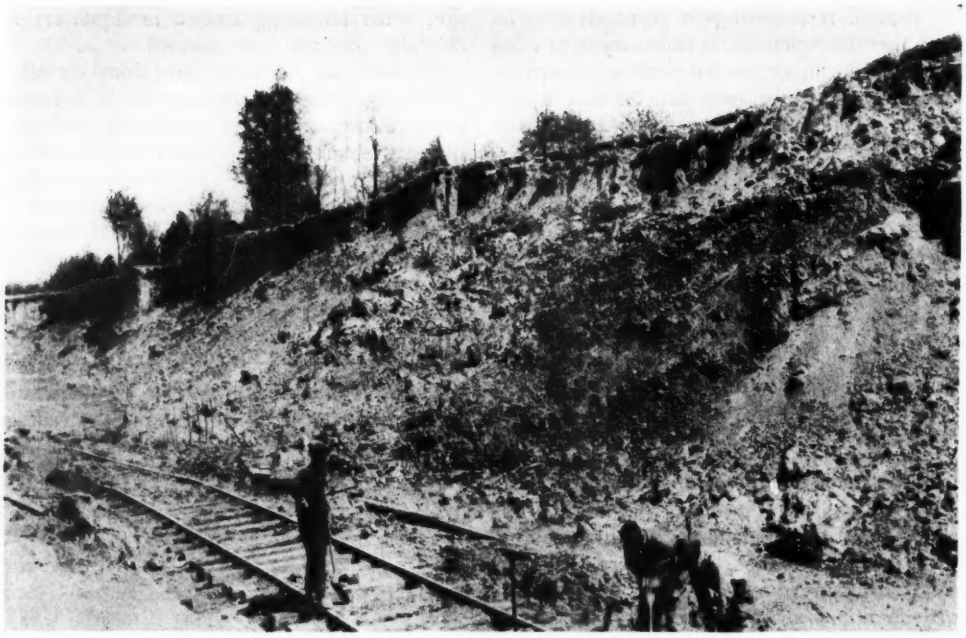
### Highway Overcrossings Demand Better Upkeep

RAILWAY bridges are heavier and stronger and possess a perfection of detail not to be found in their predecessors of past years. But the change in structures carrying railway loading is as nothing compared with the advance in highway bridge practice of the last two decades. Foremost among the changes has been the marked increase in load-carrying capacity; another is the standard of paving or floor surface that is being demanded by highway authorities; still another is the greater width of roadway—40 ft. being not uncommon now on highways in the vicinities of large cities.

Unfortunately for the railways, this transition in highway bridge practice has come during the period when the railways are being compelled to participate with steadily increasing frequency in highway bridge construction, namely, in grade separation viaducts. It is true that the problems that are thus imposed on the railways relate primarily to design, construction and finance; nevertheless the effect on maintenance practices and policies is far reaching.

While the newer structures require less upkeep, higher standards of maintenance are being demanded. The roadway must be kept in better condition, the transition from the approach to the bridge floor must be free from objectionable "bumps," and fences or guard rails must be "side-swipe" proof. But the most important duty imposed on the maintenance officer is to keep the older structures in such condition as to offer a minimum of opportunity for complaints that will give rise to demands for replacement.

Of course, if the structure is of such limited load-carrying capacity as to require traffic restrictions there is little that can be done. Likewise a narrow bridge on a heavy-traffic highway is difficult to defend. But there are many structures that serve their purpose admirably and which need only be kept in good condition to disarm the efforts of those who promote bigger and better speedways at the expense of somebody else.



A Slide in a Cut that Occurred During Construction.

# Slides Can Be Cured*

By A. F. BLAESS
Chief Engineer, Illinois Central, Chicago

**Experience of the Illinois Central with these and other roadbed problems shows that there are effective remedies**

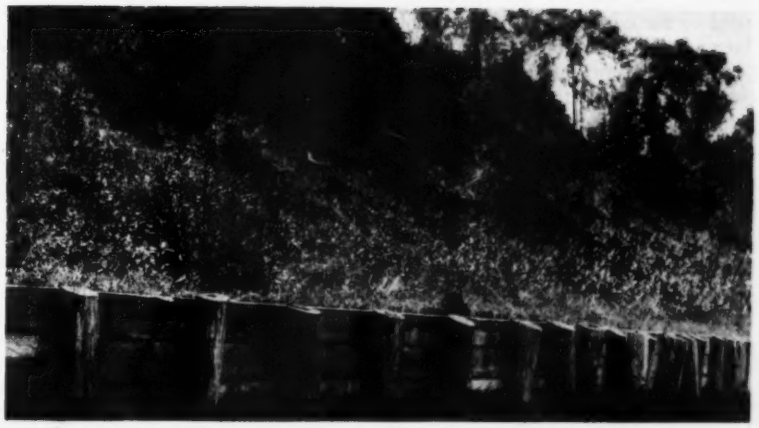
ONE of the principal problems confronting maintenance of way officers on nearly all railroads is the troublesome track conditions resulting from slides, water pockets and soft spots in cuts or fills. These cause unstable roadbeds, increased maintenance costs, speed restrictions and broken rails, and increase the hazard of accident.

The maintenance of way departments of our railroads have been endeavoring, with varying success, to develop successful and economical methods to combat these troublesome conditions and to effect permanent cures. Certain conditions apply in general to all slides, but the methods of treating individual slides differ throughout the country. It is necessary to study each slide and analyze the conditions surrounding it in order to arrive at the proper method of treatment. Adequate drainage is one of the most important requisites for a stable roadbed and is a primary factor in the successful treatment of slides, soft spots and water pockets.

Slides in cuts differ somewhat from those occurring in embankments. The methods used to prevent them also differ, although their cause is, to a very large extent, the same. In each case the cure depends largely on the providing of adequate drainage. Many slides in cuts can be traced to the fact that the cuts are too narrow and the slopes too steep. Others may be caused by disturbing the equilibrium of the material through which the cut is made, to the extent that movements of large masses of material result, which obstruct and sometimes practically fill the open cut. This is especially true if the material through which the cut is made contains strata of blue clay, shale or other unstable formations. In such cases the cut should be widened on each side of the track sufficiently to afford stability and to leave ample room for side ditches of proper size to drain the track properly and to take care of such water as may fall or be diverted into the cut. Surface water should be kept from draining into the cut by constructing intercepting ditches at the top of the bank, set far enough back from the top of the slope so that they can be properly maintained, thereby preventing surface water from coming in contact with the slope surface as much as possible. The growth of a good sod on the face of the slope, from top to bottom, has been found to be very effective. The speaker has also secured good results in several instances by planting black locust or willow trees and Bermuda grass on slopes.

The Illinois Central has experienced an unusual amount of difficulty with sliding cuts, two in particular—one

*From a paper presented before the Maintenance of Way Club of Chicago on December 17, 1930.



A Pile Retaining Wall and Brush Planting Employed to Stabilize a Sliding Slope.

located a short distance south of Curve, Tenn., known as Curve cut, and the other just north of Anding, Miss., known as Anding cut. The nature of our troubles in these two cuts was similar.

At Curve cut the original line lay in a valley about one and one-half miles west of the present location. In 1897, when the railway reduced grades and improved the alinement on this district, the new location and grade line made it necessary to excavate a cut through a hill south of Curve. This cut was about one mile long and 80 ft. deep at the deepest part. The cut was excavated for a single track with a roadbed width of 32.5 ft. and side slopes of 1 to 1. The material in the cut consisted largely of clay and was underlaid with strata of a dark lignitic clay interbedded with thin layers of fine sand, forming a very unstable material somewhat of the consistency of potter's clay. The excavation made through this hill so disturbed the equilibrium of the mass of material that the superimposed loads on each side of the roadbed bulged and squeezed up the roadbed to such an extent that it was necessary to remove not only the material which had been squeezed up but also that which had slid in from each side of the roadbed.

After several operations of this kind, it was felt that the roadbed was sufficiently stable to support the track and traffic, and, accordingly, the track was constructed and subsequently opened to traffic. For six or seven years thereafter the track was frequently obstructed by slides and upheavals, which necessitated the repeated removal of more material and resulted in widening the cut until the superimposed load on each side of the roadbed had been reduced sufficiently to prevent disturbance or displacement of the roadbed and track. During this period, side ditches in the cut were kept open and surface water drained away from the track. It was not possible to maintain subsurface tile drains, owing to the displacement caused by the sliding and squeezing action of the moving material. These operations finally resulted in conditions which proved quite satisfactory.

In 1914 it was decided to reduced the grades in this district to 0.5 per cent and construct a second main track, which entailed further excavation in Curve cut. In this operation the existing track through the cut was not disturbed and traffic was handled over it during the construction of a new subgrade about six feet below and far enough east of the existing grade to permit the construction of two new tracks. The lowering of the grade for the new tracks was done with a steam shovel, and by the time the shovel reached the deepest part of the excavation trouble again developed. The new roadbed began to squeeze and heave up and the material crowded in from both sides, but chiefly from the east side, for apparently the old roadbed and track acted as a barrier and retarded the movement on the west side. To overcome this upheaval and slide, the cut was widened and more material was removed than would have been the case otherwise, until, after quite a number of these upheavals and slides, the new grade was completed and the tracks constructed and put in operation.

A Bad Slide in a New Fill.

### The Remedies Applied

It was concluded that sufficient of the superimposed load had been removed prior to placing the line in service to stabilize conditions. Unfortunately this was not the case, and, for several years after the line was opened, these upheavals and slides resulted in further expense and frequent interruptions to traffic. Further study led to the following corective measures:

(a) The superimposed load was reduced on the east side of the track (the side of the track giving trouble) by removing a large part of the sliding material, thereby widening the cut.

(b) The slopes were flattened and evened by means of a dragline operated from a point on the top of the bank back of the point where the bank had broken off and caved in. This not only lightened the load but made it possible for water which fell within the area of the trouble to pass off more freely instead of soaking into the ground.

(c) A series of trenches were constructed 6 to 8 ft. deep and 3 to 3½ ft. wide with a slight grade towards the side ditches in the cut, so they would drain; and these trenches were filled with alternate layers of old ties, coal and clay, and burned with the idea that this would form more or less of a vitreous mass and assist in the drainage. This was not entirely successful, as the nature of the soil did not prove satisfactory for such treatment.

(d) A strong bulkhead was built about 18 ft. from the center of the track with sufficient room between it and the track to permit a good ditch to be maintained. Several years later tile drains were installed in the side ditches on each side of the track.

Since these remedies were applied we have had little trouble with this cut and no further interruptions to

traffic. Undoubtedly all of the above schemes contributed to the correction of the trouble, except possibly the burning. The timber bulkhead has proved very effective.

Our difficulties at Anding cut, previously referred to, were very similar to those experienced at Curve Cut.

### Sliding Embankments

In addition to its experience with sliding cuts, the Illinois Central has also had its full share of troubles with sliding embankments, soft spots and water pockets. Slides occur in embankments, not only in clay and other unstable soils, but also on inclined rock or shale surfaces supporting almost any kind of material, providing water has an opportunity to reach and run along the face of the rock.

Some of the ordinary conditions that cause water pockets, soft spots and slides are:

(1) Irregularities in the surface of the subgrade, where the character of the soil is such as to hold water.

(2) The building up of new shoulders of embankments with clay or other impervious material above the bottom of the ballast, thereby impounding the water and obstructing the drainage.

(3) The settlement of track in wet cuts and on fills during rainy seasons and soft thawing spells, forming troughs in the subgrade from which the water cannot escape.

(4) The construction of the subgrade for a second track or siding above that of the old subgrade and filling the side ditches.

(5) The use of an improper kind of ballast on new fills made of clay or other material impervious to drainage.

(6) The introduction of heavier wheel loads on locomotives and cars and the increased speed of trains. This has resulted in the deforming of the roadbed to create water pockets or so-called troughs under the track in localities where formerly no trouble had been experienced.

The difficulties above referred to are especially troublesome where the roadbed is of material that does not drain freely and becomes unstable during wet weather. In some instances the troubles can be cured by the installation of tile subdrainage, intercepting tile ditches and French drains; by increasing the depth and quality of the ballast, thereby distributing the load over a greater bearing area and reducing the unit pressure; and by lowering the roadbed shoulder to permit drainage of the roadbed. Of course, the extent to which these remedies can be applied is often limited by the expenditure required, but it should always be borne in mind that it costs much in labor to protect traffic properly and maintain good line and surface over unstable places in the track, and that frequently a comparatively small amount spent to remedy such conditions will bring a good return on the investment.

### Water Pockets

The Illinois Central experienced a great deal of trouble in maintaining good line and surface on new second track in main-line territory in certain localities in central and southern Illinois, and between Cairo, Ill., and Memphis, Tenn. This trouble was not caused by slides but was due largely to soft places and water pockets.

Through Illinois the roadbed consists largely of embankments constructed of black soil secured locally. In constructing these embankments, care was exercised to keep the new embankments below the top of the subgrade of the existing roadbed, and the subgrade for the new track was so graded that it would drain properly. The track was laid on the new roadbed and ballast trains were run over the skeleton track for the distribution of the ballast, which consisted of crushed rock.

The completed job had the appearance of stability and permanence and for some time required only the amount of labor that would reasonably be expected to maintain good line and surface on a newly constructed track under heavy traffic. But, after sufficient time had elapsed for the embankment to settle and considerable traffic had been handled over the track, pumping joints and churning track developed in many locations. It was hard to maintain good line and surface and it was necessary to resurface and line the track frequently.

It developed that the material in the subgrade at these locations was mixing with and working up through the ballast, forming ridges between the ties and also squeezing up the shoulders at the ends of the ties. To remedy this the shoulders were plowed down and leveled off. All of the ballast on the shoulders and in the track to the bottom of the ties was thoroughly cleaned by forking, and sufficient new ballast was added to raise the track from six to eight inches. It was felt that this treatment would correct the difficulty and it did so for a short time. However, the same conditions gradually developed again, and the same remedies were applied several times, but they did not effect a permanent improvement. In addition to these measures, lateral drains were installed in many instances and old flues were driven into the embankment from the sides to tap the water pockets or troughs under the track, but while of considerable benefit in improving the drainage, they did not entirely correct the faulty condition of the track.

### Chatts Prove Effective

After further study, it was decided to plow down the shoulders with a spreader at the locations of greatest difficulty, skeletonize the track to the bottom of the ties and apply sufficient chatts ballast to make a raise of from eight to nine inches. It was found that the dirt would not mix with the chatts as it did with the rock ballast and that the chatts formed a very good sub-ballast upon which rock ballast could be re-applied later, when conditions warranted. This treatment was successful and resulted in track on which it was not difficult to maintain line and surface and on which the maintenance cost was not in excess of that of ordinary main-line track.

Our experience in Tennessee was similar to that in Illinois, except that the soil of which the embankments were built in Tennessee, was largely of clay. The same general methods were followed in correcting the troublesome conditions except that cementing gravel instead of chatts was used for the sub-ballast. The gravel is particularly suitable for use on new roadbed as a sub-ballast upon which rock or slag can be applied at a subsequent date. Cinders, limestone screenings and granulated slag also make good sub-ballast. It has been our experience that the use of rock ballast on green fills or in soft spots in roadbeds is inadvisable.

The primary cause of slides and soft spots in roadbeds is the lack of proper drainage. The wet condition may be due to water from seepage or springs but it is generally from rainfall, the amount of which varies greatly in different sections of the country. On the Illinois Central it ranges from 25 in. on an average, in South Dakota, to 65 in. in Southern Louisiana and Mississippi. We have had a great deal of trouble in these semi-tropical states with slides, due to the heavy rainfall and also to the character of the material used in building our

embankments. The particular territory I have in mind is the Mississippi Delta, in which we have a large track mileage. This is a flat country with few hills, and a very large percentage of our track is located on fills.

The material from which many of these fills are built consists largely of buckshot or gumbo clay. When this material becomes wet, its bearing power is greatly diminished and, with heavy wheel loads passing over it, the material slips and squeezes out readily. The embankments in this territory average from two to eight feet in height. Owing to local conditions, it was not always possible to construct the borrow-pits so that they would drain and many locations were left with borrow-pits improperly drained.

The track laid on these banks was originally ballasted with a pit-run material of poor quality, secured locally. It was practically impossible to maintain a reasonably good line and surface on a large portion of this railroad.

**Two Views of a Crib Wall Built to Close a Break in a Berm Ditch Half Way Up the Side of a Deep Cut.**

An effort was made to improve conditions by applying river gravel. Before applying the gravel the banks were carefully prepared. Where the shoulders had squeezed up they were plowed down and sufficient ballast was distributed to give about a 12-in. raise under the ties. This gave only temporary relief, for while conditions were fairly good for a short time after the work was completed, trouble soon developed again and it was not long before the banks began to squeeze out, break off and slide out from the ends of the ties, frequently as far in as the rail.

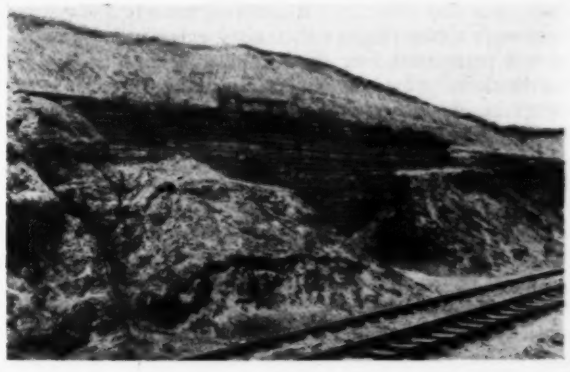
### Further Remedies

Special efforts were made to get rid of the water by proper drainage wherever possible. The borrow-pits were filled and leveled off at many places, the right of way was sloped away from the track and longitudinal ditches were constructed near the outer edge of the right of way. The slopes were flattened in many instances, slide piling was driven into the shoulders near the edges of the embankments, and lateral tile drains and French drains were installed. However, it was not long before the squeezing distorted the drains and filled in the voids so that they did not function. Furthermore, the nature of the soil of which the embankments were made was such that, even though a water pocket under the track was tapped by a lateral drain, the material was so impervious that it would not drain another pocket which might be only two or three feet away. We also increased the bearing surfaces in some instances by applying greater depths of suitable ballast.

All these methods were, of course, of some help and served in some measure to improve conditions. Flattening the slopes was quite effective, and the driving of slide piling has also been successful; in fact, we are driving a great deal of slide piling at the present time for it can be done at a fairly reasonable cost and results in immediate improvement in track conditions, thus decreasing maintenance costs. The one thing, however, that was most effective and resulted in a permanent cure was the digging out and replacing of the unstable material with suitable material. This can best be explained by a description of a troublesome location on the Yazoo & Mississippi Valley.

### A Fill Rebuilt

The most troublesome condition was encountered where there was a sliding embankment for a distance of 6.5 miles. After exhaustive study and a thorough trial of all the methods previously described, the following method of treatment was decided on and carried out: One side of the fill was excavated to within about six feet of the center-line. This excavation was refilled with good sand loam taken from hills near West Junction, Tenn., about seven miles south of Memphis, and widened sufficiently to permit the construction of a new track. After the new track was constructed on the new fill, the old track was retired and the old fill plowed and leveled down below the subgrade of the new fill and



abandoned. The excavating was done with a caterpillar-mounted, ¾-yd. shovel, working two 10-hr. shifts.

When excavating the sliding embankment, the spoil bank was placed outside of the slope of the new fill and the material distributed over as wide an area as the boom of the shovel would permit. This caused the longitudinal side ditches to be filled. Sufficient open spaces were left in the spoil bank to provide proper drainage to a new longitudinal ditch which was dug near the other edge of the right of way. The estimated cost of treating this stretch of track, including $5,062.86 for the acquisition of some additional right of way, was $192,650, and the estimated annual saving was $17,950, a return on the expenditure of approximately 9 per cent. In addition, this treatment effected a permanent cure and resulted in first-class track on which, since the new fill has become settled and solidified, there has been absolutely no extra maintenance.

This stretch of track, south of Clarksdale, is the longest treated by the method as herein described, but it is typical of the treatment applied to many shorter sections in the Delta with permanent success in each case.

The New South Portal of the Sand Run Tunnel.

# How the Baltimore & Ohio Lines Tunnels

**Confronted with the problem of maintaining tunnels through materials that differ widely in stability on lines of varying density of traffic, this road has developed practices that are worthy of wider application**

THE experience gained by the Baltimore & Ohio in lining and in repairing the lining of the many tunnels on its line has culminated in the formulation of methods and practices which should be of interest to other roads as practical, economical and effective. In unlined tunnels and those with timber linings that need extensive repairs, a permanent four-ring lining of hard vitrified brick is provided, while in repairing brick linings in which the inner ring of brick has worn through, disintegrated, or become loosened by reason of locomotive blasts, the character of the brick, the mortar, the workmanship, or a combination of these, the cement gun has been found effective, substituting for the inner ring of brick a reinforced concrete coating about 2½ in. thick. The two most recent tunnel jobs on this road illustrate clearly the above methods, these being the application of a brick lining to an 812-ft. tunnel near Sand Run, W. Va., which was formerly lined with timber, except for the two short sections of brick lining, and the repair of a section of the lining in the road's brick-lined tunnel under Fairmont Park in Philadelphia, Pa.

### Description of the Sand Run Work

In the case of the Sand Run tunnel, work on which is still under way, the problem was not only one of providing a new lining, but of enlarging and retimbering to a considerable extent. This tunnel, a single-track bore, was driven in 1904 and 1905 in the construction of the Coal & Coke railroad between Elkins and Charleston, W. Va. It extends through most unsatisfactory material, consisting mainly of coal, limestone and soft shale, streaked at places with soapstone.

The old lining consisted of timber, except for 16 ft. of five-ring brick lining at each end of the tunnel. The timber lining was made up of 10-in. by 10-in. wall posts, wall plates and nine segment arch members, with the wall posts and arch rings spaced approximately five feet center to center. Lagging had been used in the arch of the lining, and this, as well as many of the timber posts and arch members, was in poor condition and needed to be renewed. The new lining, which is about half completed at the present time, provides a vertical clearance of 20½ ft. from the top of rail to crown, and a clear width of 17 ft. between plumb side walls.

In carrying out the work, two entirely independent crews have been employed, one at each end of the tunnel, this arrangement having been adopted to speed up the work without the congestion which would result if a single crew of sufficient size to make similar progress was worked in one section of the tunnel. A further purpose in the employment of two independent crews was to secure the benefit of increased output and better workmanship through competition between the crews, a purpose which has been fully realized in the work thus far.

### Work Was Practically Uniform

Conditions for such competition are almost ideal in the tunnel work since the character and extent of the work are practically uniform throughout and since the methods being employed are the same. Furthermore, the crews are maintained of equal size and are fitted out with similar equipment. Fortunately the equipment necessary involved a relatively small outlay so that overhead charges were not increased materially by duplication. In view of the similarity of the conditions and of the methods em-

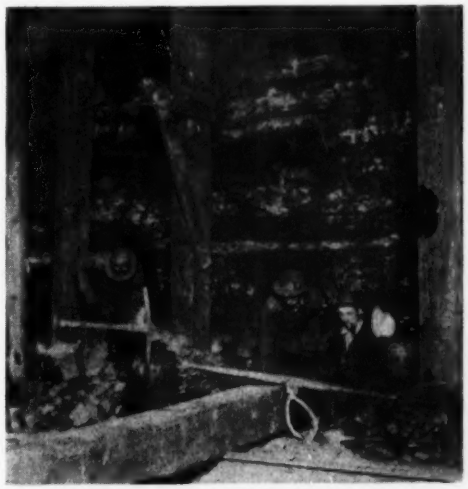
ployed in the work at both ends of the tunnel, the work at the south end only will be described, except in so far as it is desirable to direct attention to certain features in the work at the north end.

Having decided upon the use of a four-ring brick lining, it was recognized that this involved the lengthening of the tunnel five feet at each end, the construction of new brick portals, the demolishing of the old brick portals and the 16-ft. sections of brick lining at each end, and the renewal and setting back of the tunnel timbers, in addition to placing the new lining. The work was scheduled, therefore, to start with the construction of the new portals and progress inward so that the center section of the tunnel could be completed during the winter.

The portals are of brick masonry with concrete copings, a pilaster being provided on each side of the tunnel opening and a horizontal cornice across the face just above the tunnel arch for purposes of appearance. A further pleasing touch was given to the portals by setting out in plaque form across the top, the words, "Sand Run", and the date, "1930".

### Much Retimbering Necessary

While the portals were being constructed, crews at each end removed the short sections of brick lining adjoining the old portals and installed such temporary timbering in these sections as was found necessary. Progressing inward, these crews have continued to renew and set back the old tunnel timbers, a task which has involved many difficulties and fully as much labor thus far



**Renewing and Setting Back the Timbering in the Sand Run Tunnel.**

as that required to install the brick lining. In this work some readjusting of the spacing of the old lining bents has been found necessary to meet special conditions and to facilitate the renewal operations. This has resulted in increasing the spacing generally between wall posts and arch rings to about eight feet center to center, except for about 150 ft. in from the south portal and 225 ft. in from the north portal, where the new arch rings were placed on approximately five-foot centers.

Ten-inch by ten-inch timbers are being used in this work, with two-inch by eight-inch timber lagging where necessary, employing such of the old tunnel timbers as are found in good condition. All of this reset timbering is considered as temporary since it is the practice of the Baltimore & Ohio to keep to a minimum the amount of timber back of its brick tunnel arches, having in mind the possible decay of the timber and failure from the resulting non-uniform loading on the arch ring. As the masonry work has progressed, therefore, as much of the temporary timbering as could be removed with safety has been taken down and moved ahead for reuse. Alto-

**Laying Up the Lower Sections of the Lining Walls.**

gether, it is expected that about 50 per cent of the temporary timbering will be removed from the tunnel as the brick lining is installed.

In the actual work of retimbering, new wall post footings are being excavated to a depth of two feet below the top of rail and the walls of the tunnel are being recessed a sufficient distance to permit the placing of the wall posts on opposite sides of the tunnel with a clear distance of 20 ft. 10 in. between their inner faces. This provides adequately for the new 17-ft. width of tunnel with 17-in. walls on each side and about six inches of space behind them for packing. It has been necessary to exercise the greatest precaution in this work to prevent the caving of the soft disintegrated material in the side walls, not only for reasons of safety, but also to prevent the formation of large openings which would have to be back-filled later.

The scaling or breaking down and retimbering of the tunnel roof accompanies the resetting of the wall posts and is being done from an overhead platform, 14 ft. long, supported on three timber bents. These bents, which are of sufficient size to permit train movement through them, are framed together and supported on timber sills so that the platform as a whole can be moved forward on pipe rollers as the work progresses.

All of the enlarging work within the tunnel is being done with pneumatic drills, those in the north and south ends of the tunnel being supplied with air by Ingersoll-Rand tie tamper compressors of four-tool and eight-tool capacities respectively. The compressors are set off on timber cribbing near the portals.

The larger compressor was placed at the south end of the tunnel to take care of an expected larger demand for air at that end, and, as further insurance of a constant supply of air for carrying out the work in the south half of the tunnel, a large vertical boiler-type air reservoir was arranged in the discharge line of the compressor. The delivery lines from both compressors are of two-inch pipe and carry air at 90-lb. pressure.

The next step in the lining work is the construction of the wall footings, this involving the excavation of a trench along each side of the tunnel to a depth of 48 in. below the top of rail. The footings themselves, which are

being made of 1-3-5 concrete, are 2½ ft. wide and 2 ft. thick.

The concrete for the footings is mixed directly alongside the forms in a ¼-yd. tilting batch mixer mounted on a trailer car for operation on the track, and the concrete is shot directly into the forms. The cement and aggregates are brought into the tunnel by a motor car pushing two trailers equipped with side boards, one of which is used for sand and the other for stone. Cement for the mix, which comes in paper sacks, is carried in the tool trays of the motor car or on top of the aggregates. While the cement is being carried from the motor car or the trailers, the aggregates are shoveled directly into the elevating batch pan of the mixer. Water for the mix is piped into the tunnel through a ¾-in. line, with a flexible hose connection to a water tank on top of the mixer.

**Backfilling the Walls with Concrete.**

The construction of the side walls is the next step in the work, this being done by a crew of brick layers on each side of the tunnel, who are supplied with bricks and mortar by the same train which delivers the materials to the concrete mixer. A special grade of vitirified brick, 3 in. thick by 4 in. wide and 8½ in. long, is used throughout the lining. Specifications for this brick require that it shall have a crushing resistance of not less than 6,000 lb. per sq. in., and that, when broken into two parts and immersed in water for 24 hrs., it shall not absorb in excess of three per cent by weight.

The advantages of using this high grade of brick on the inner face of the walls and the inner ring of the arch are apparent, and it is for practically these same reasons —to prevent moisture penetration and disintegration and failure from crushing, omitting the action of the locomotive blasts—that it is felt advisable to use the same quality of brick throughout the thickness of the lining. Crushing resistance in the outer ring of the arch is considered of special importance because it is easily demonstrated that in heavy ground under uneven loading, conditions may exist where the greatest crushing force will be on the bricks in the outside ring, which, if they fail, may cause complete failure of the lining.

In building up the side walls, the bricks are laid with their 4-in. by 8½-in. face up, and every fifth course is put in as headers. This gives the four-brick walls a thickness of 16 in. plus the thickness of the mortar between bricks. Twenty-foot sections of wall are completed at one time, this being the length of the centering used in the construction of the arch. At the end of each of these sections, the wall is tied back to the face of the rock by a brick spandrel wall which serves also as a bulkhead to retain the concrete which is used as backing behind the wall.

At each third point in the height of the walls, brick laying is stopped and the space behind is filled with 1-3-5 concrete, one-man stone being imbedded in this backing back of the front faces of the wall timbers. At the same time, an unusually complete system of tile drains is installed in the backing, a feature which will be described later.

### Electric Hoist Lifts Materials for Arch

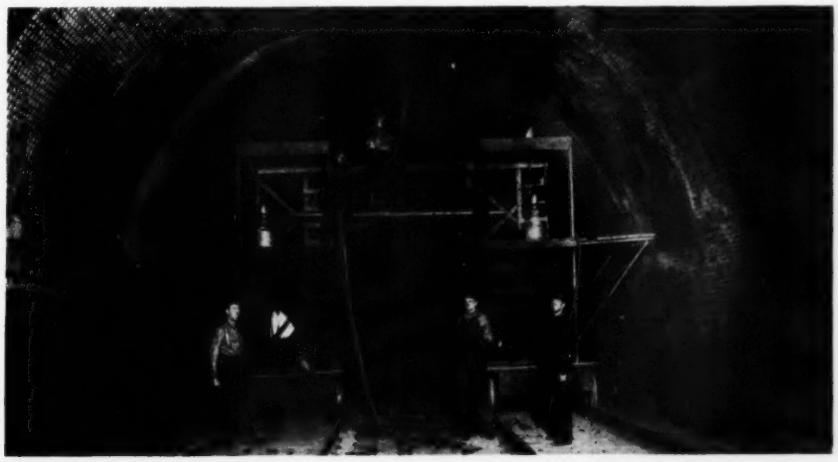
With the completion of a section of side walls, the masonry gang moves back to a section of the tunnel where the new walls have set up securely and proceeds to construct the arch ring. This work is done with the aid of a 20-ft. section of arch centering, which is constructed of timber throughout and in such manner that it can be raised or lowered as a unit and moved forward on a series of pipe rollers. Three working platforms are provided in the centering, these including a hinged platform on each side at the spring line, which can be dropped to a hanging position to clear for traffic, and a fixed platform extending across the track between the ring segments of the centering, 15 ft. 7 in. above the top of rail.

**A Close View of a Section of New Timbering in the Sand Run Tunnel and the Platform Used in the Work.**

A special feature in connection with the arch centering is a material platform which is constructed integral with the inner end of the centering and at the same height as the fixed working platform of the centering. This auxiliary platform is used for the receipt and storage of all materials employed in the construction of the upper section of the arch, and in packing. The platform is served by a low-head electric hoist of ½ ton capacity, furnished

by the American Engineering Company, which is hung from the cross beam of a special timber bent erected over the platform. With this hoist, which has a hoisting speed of 80 ft. per min., brick, mortar, concrete, rock and other materials used in the arch are readily conveyed to the platform in a specially constructed bucket, without physical effort.

The bucket is merely a low-side container of steel plate construction, about three feet square and one foot deep, with one side hinged at the bottom for dumping. Four corner chains are provided for lifting the bucket, these meeting in a ring over the center. The bucket is raised and lowered through a hole in the material platform, and is dumped by unhooking the chain connections to the hinged door and then taking up on the hoisting line.



**Applying the Gunite Lining in the Fairmont Park Tunnel From the Scaffold Cars.**

Power for the operation of the hoist at the south end of the tunnel, and for the similar unit at the north end, is supplied by an Electric Tamper and Equipment Company's electric tie tamper power unit, which is set up on cribbing about 50 ft. south of the south portal.

In constructing the arch, the timber to be removed is taken out carefully and the brick is carried up from both sides in much the same manner as in the side walls, setting in the lagging of the centering as the work progresses. Back-filling with concrete and one-man stone keeps pace with the brick work, and from a depth of six inches over the key section of the arch, the concrete is battered off toward the sides of the tunnel on a one-to-six slope to insure the run-off of seepage water. Above the concrete drainage plane, one-man stone of good quality is wedged tightly into place as packing.

### Tile Drainage System Installed

One of the most interesting and unusual features of the tunnel lining work is the drainage system that is being installed behind the tunnel walls to insure an absolutely dry lining. This system, in which 6-in. by 6-in. vitrified tile with holes punched in one side, is being used, consists of a series of downcomers spaced from 10 ft. to 20 ft. apart, depending upon the water conditions encountered, with three levels of sloping laterals leading into them from each side. The lowest line of laterals is laid near the top of the wall footing; the second line is at about the mid height of the walls; and the third line is at such height that the highest point in the laterals between downcomers collects the run-off from the sloping surface of the concrete backing over the tunnel arch.

Throughout the drainage system, the punched faces of all of the tile are placed toward the natural walls of the tunnel, and all of the tilework is kept back of the front face of the tunnel timbers that are left in place. All seepage from the drainage system discharges from downcomer outlets in the bottoms of the walls and is carried off in the rock ditches along each side of the tunnel.

Two entirely independent lining crews are employed in the Sand Run tunnel, each consisting of an assistant foreman and 25 men under one foreman in charge of the entire work. The assignment of the men in each crew varies to some extent with the stage of the work, but ordinarily eight men are engaged in bricklaying, two men install the drainage system, from four to six men renew and set back the tunnel timbers, one man attends to the power supply equipment, from four to six men haul materials and prepare the concrete, and several helpers aid where most needed. One blacksmith at the tunnel does all of the smith work for both lining crews, which consists of the sharpening of drill points.

Since the work is still under way and is not expected to be completed until next spring, it is impossible to give actual cost figures on the lining work as a whole. However, similar work completed in recent years, and differing only in the amount of enlarging and retimbering necessary, has cost in the neighborhood of $135 per lineal foot.

### Lining Repair in Fairmont Park Tunnel

In the case of the tunnel under Fairmont park, which is a double-track 30-ft. bore on the main line between New York and Philadelphia, 0.8 miles east of the passenger station in Philadelphia, the problems encountered were entirely different from those at the Sand Run tunnel. This tunnel, which is 2,303 ft. in length and of adequate clearance, had a five-ring brick lining through the arch, with stone side walls except in certain sections which had been faced with brick. Except for a distance of 268 ft. near the center of the tunnel, the arch lining was intact and needed no attention. In this length, however, particularly directly over the eastbound track, which is on an ascending grade of 1.12 per cent, the inner ring of brick had been practically worn through or had been loosened from the second ring by the blast of locomotives.

Under the old method of repairing such conditions in brick-lined tunnels on the Baltimore & Ohio a new inner ring of brick would have been applied, bonded as well as possible to the exposed second ring. This method has been satisfactory in some cases but ordinarily great difficulty has been experienced in securing an adequate bond

with the old bricks above the 45-deg. lines of the arch.

Another difficulty encountered with this method of repair, and one which definitely precluded its use in the Fairmont Park tunnel, is the necessity for using arch centering to carry the new arch ring. Without excess clearance, the use of centering in the Fairmont Park tunnel would have interfered seriously with the movement of trains, and could not be permitted.

In carrying out the repair work in this tunnel, therefore, which was started about the middle of February, 1929, and has been completed, the entire inner ring of brick over the affected area was removed down to the spring line on each side of the tunnel, and then, except for the first three feet above the spring line on each side, which was renewed with brick, a 2½-in. course of concrete, reinforced with wire mesh, was applied directly to the second ring of the old brick lining by means of a cement gun.

**Cement Gun in Fairmont Park Tunnel. Note the New Brick and the Reinforcing in the Arch.**

The brick was renewed to the height of three feet above the spring lines to provide stable haunch-like supports for the gunite lining, and was accomplished without the use of centering or forms. In this work, which at places was carried considerably below the spring lines where the old brick appeared to be loose, a hard vitrified brick, similar to that employed in the lining of the Sand Run tunnel, was used, and every seventh course was put in as headers to insure a firm bond to the old brick backing.

The removal of the old worn and loosened brick from the inner ring of the arch was done with bars and hand hammers and chisels, working from portable scaffolds, which will be described later. Following this, the reinforcing was hung, and then, just in advance of the application of the concrete lining, the surface of the old exposed brick of the second ring was sand-blasted and washed down to insure a clean solid bonding surface for the concrete.

The reinforcing used in the arch lining was No. 10 electric-welded mesh with three-inch squares, furnished in large flat sections. As placed in the arch, these sections were made to lap for a distance of three inches at all intersections and the bottom edges of the mesh at the point of junction with the new brickwork above the spring line on each side, were lapped back on themselves for about four inches to provide for a doubly reinforced thickened section of concrete at these points. The mesh was fastened by wires to ¼ in. by 4½ in. wedge anchor bolts, driven into the old brickwork on about 24-in. centers. Holes for the anchor bolts were drilled with Ingersoll-Rand 3R pneumatic drills, using ½-in. drill points, the depth of the holes being made sufficient to permit the anchors to protrude from 1 in. to 1¼ in. from the brickwork.

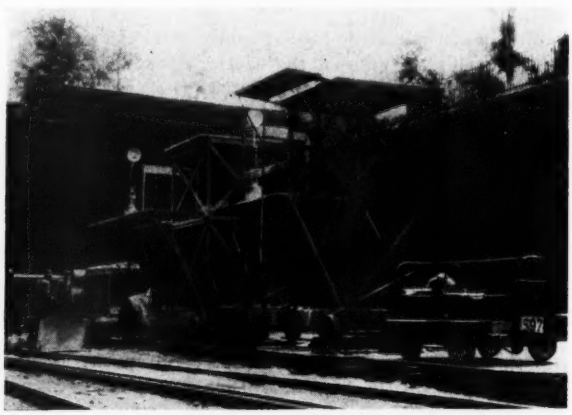
Sand blasting was done with a cement gun set in a deepened refuge niche, the sand being conveyed from the gun to a ½-in. sand-blast nozzle through a 1¼-in. rubber hose. As this work was done only a day or two in advance of the concrete work, there was little time for the accumulation of soot from locomotives, and such soot as did adhere to the cleaned face was washed off in a wetting down process which was applied to the brick and reinforcing mesh just prior to the application of the concrete.

## Applying the Gunite

The concrete lining was applied with a cement gun, similar to the machine used for the sand-blast work, equipped with a 1-in. Gunite nozzle and suitable lengths of 1¼-in. rubber hose for shooting the concrete for distances up to 125 ft. Like the sand blast machine, the Guniting machine was housed in refuge niches of the tunnel, which had been enlarged, and was supplied with air furnished by two air compressor units set up at the east portal of the tunnel.

The compressors used were a Metalweld-Worthington unit with capacity for 280 cu ft. of air per min., and an Ingersoll-Rand unit with a capacity of 250 cu. ft. of air per min. These units delivered air to air storage tanks in the discharge line, from which a 1½-in. pipe carried the air to the gun within the tunnel.

All of the sand and cement used in the Gunite mix was proportioned and mixed at a suitable point near the west end of the tunnel and was carried to the gun on a motor car trailer in canvas tote bags of 1½ cu. ft. capacity. These were lined up along the tunnel wall in the vicinity of the gun and were replenished as used. The usual charge of the gun was about 5 cu. ft.



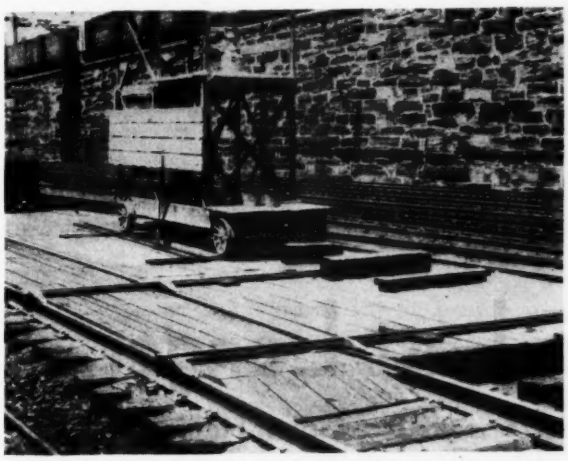
**The Equipment Used in the Fairmont Park Tunnel, in the Clear for Train Operation.**

In preparing Gunite for application, the dry mix is placed in the gun, but the water is supplied under pressure directly to a mixing chamber in the spray nozzle, where it first comes in contact with the sand and cement.

In the Baltimore & Ohio work, the water was supplied through ¾-in. pipe with a section of ½-in. flexible hose attached to the nozzle. The pressure was maintained between 60 lb. and 90 lb. per sq. in. by a Fairbanks-Morse Typhoon booster pump, capable of delivering 2,500 gal. per hr.

### Readily Removable Scaffolds Used

The Gunite was applied in three courses, to a total average thickness of about 2½ in., the different courses being applied at intervals of not less than two hours. This work was done from two scaffold cars improvised of timber framing mounted on trailer car axles with two



**The Equipment Platform at the Fairmont Park Tunnel Showing the Pipe Scaffold Car Skids.**

rigid platforms of about equal size; one about 7 ft. and the other about 11 ft. above the top of rail. In addition to the main platforms, each scaffold car had two hinged extension platforms, one extending from the low rigid platform to within a few inches of the side of the arch ring, and the other extending from the high rigid platform, on the opposite side, to within a few inches of the center-line of the tunnel. Both of these wing platforms were provided with pipe braces, which were pivoted at the top and provided with socket seats at the bottom., whereby they could be dropped readily to a hanging position along the sides of the main scaffold tower.

Working under traffic with this equipment, which was given adequate protection, the two scaffold cars were used either in tandem on the same track or across from each other on opposite tracks, depending upon the character of the work and the part of the arch being worked upon. When operated in conjunction with each other on opposite tracks, the two high wing platforms formed a practically continuous platform over the inter-track space for working close to the arch ring, and planking placed between horizontal members of the framework on each car provided a lower platform over the inter-track space for operating the concrete gun, which was normally held about four feet from the surface being coated. The low wing platforms on the sides of the cars made the lower sides of the arch readily accessible for the various classes of work performed.

When clearing for trains, the wing scaffolds were lowered and the scaffold cars were pulled to the east end of the tunnel by track motor cars, one or two motor cars being used as required Just outside the east portal on the south side of the eastbound track, adjacent to the air compressors, a plank platform was provided at rail height for setting off the scaffold and motor cars, this platform extending between the rails of the eastbound track and across the inter-track space and the westbound track at one point. In addition to this convenience in derailing and rerailing the cars, a simple, yet highly effective, skid arrangement was improvised to aid in moving the scaffold cars from the track to the platform, and vice versa, readily, without the use of jacks or excessive physical effort.

### Pipe Skids for Setting Off Scaffold Cars

This arrangement consisted of portable skidways built up of two 16-ft. lengths of 1½-in. galvanized pipe, spaced 8 in. center to center and held rigidly in this position by strap iron tie members which extended across and between the bottoms of the pipes to bolted connections on the outer sides of the pipes. This method of tying the pipes together left the top faces of the pipes unobstructed so that wheels set in the skidway formed, in planes at right angles to the pipe lengths, could be skidded back and forth with little effort. To minimize friction on the skidways the pipes were kept well greased.

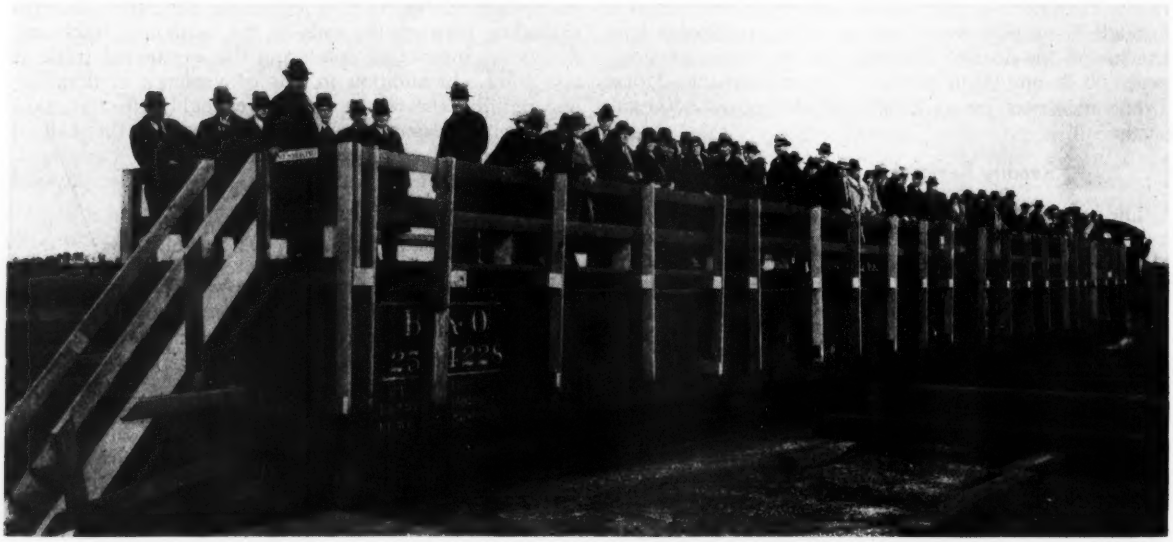
In removing a scaffold car from one of the tracks, the car was spotted directly opposite the point at which it was to be placed on the platform and two sections of the pipe skidways were pushed under the car, at right angles to the track and platform and just ahead of the front and rear wheels. Four wooden wedge blocks, equal in height to the diameter of the pipe in the skidways, were then placed on the heads of the rails between the car wheels and the skidways, and the car was pushed up over these blocks and into the skidways. The car was slid laterally over the skids by three or four men who then rolled it out of the skidways on to blocks on the platform, after which they either removed the skidways or slid them back to clear the tracks. The cars were placed on the tracks by reversing the operations of derailing, and in both cases, the time required was only about two minutes.

### Small Force Employed

All of the work in the Fairmont Park tunnel was carried out with a force of 16 men including a foreman, an assistant foreman, 3 flagmen and 11 workmen, assisted by 3 men furnished by the Cement Gun Company during the first two months. Most of the work was done between the hours of 6:30 a. m. and 2:30 p. m., the period of lightest traffic through the tunnel, and the various operations were scheduled to make the most effective use of the men and to produce the most effective results.

Because of the limited amount of work to be done in the tunnel, which would not have justified the building up of a large gang with separate crews to handle each class of operations, the relining work was done in short sections by the entire force, concentrating for a limited period on one class of operations at a time. Thus, for about two days at a time, the entire force hung the reinforcing mesh and sand-blasted the surface to be Gunited. When a suitable section of the tunnel had been thus prepared, the full force was put to Guniting and finishing-up work. Careful examination of the work in which the entire lining was tested with a hammer indicates that the lining material is both hard and dense, and that it has perfect bond with the old brickwork.

All of the tunnel work on the Baltimore & Ohio is planned and carried out under the direction of Earl Stimson, chief engineer maintenance, and under the direct charge of G. F. Eberly, assistant maintenance engineer.



Convention Party Inspecting the Baltimore & Ohio Treating Plant at Green Spring, W. Va.

# Making Timber Last Longer

## Wood Preservers dicuss ways to increase life of crossties, bridge materials and other wood in railway service

WITH an attendance totaling within ten of the all-time record, the twenty-seventh annual convention of the American Wood-Preservers' Association, which was held at Philadelphia, Pa., on January 27-29, demonstrated the widespread interest of railway men and others in the use of wood for permanent and semi-permanent as well as temporary construction. As in past years, the program was devoted largely to the consideration of those phases of timber treatment applicable especially to railway service and to the development of refinements in treating practices. All sessions were presided over by C. C. Cook, president of the organization and maintenance engineer of the Baltimore & Ohio.

At the annual election during the closing session of the convention, John S. Penney, vice-president, T. J. Moss Tie Company, St. Louis, Mo., was elected president; Elmer T. Howson, editor, *Railway Engineering and Maintenance*, Chicago, first vice-president; R. S. Belcher, manager treating plants, Atchison, Topeka & Santa Fe System, second vice-president; H. L. Dawson, secretary-treasurer (re-elected), and F. C. Krell, forester, Pennsylvania Railroad, and R. S. Manley, president, Texas Creosoting Company, Orange, Texas, directors.

### Treatment Increases Selection

In his opening address, President Cook called attention to the fact that preliminary census figures show that for the year 1929, the output of treated products had a total value of $234,000,000 and that wages of nearly $15,000,000 were paid to 13,000 employees in the industry. "Researches into new and larger fields," he said, "do not blind us to the necessity of continued attention to those major problems of standard practices relating to the selection and preparation of timber for treatment, methods of treatment, preservatives, care of treated material and its preferential use. The varieties in kinds of wood, in climatic conditions under which it is seasoned, in character of preservative and process of treatment required for the special service to which it will be subjected, demand constant survellance.

"Reduction of supply in woods of superior quality necessitates refinement of action in preparation and treatment of the kind of timber next found most durable. In treated timber relative durability is not inherent alone in the structure of the wood. Seasonable cut, proper seasoning and right treatment may easily render woods relatively inferior and of a less desirable grade more serviceable than other normally more durable timbers which have been subjected to less intelligent treatment.

"And the exhaustion of these superior woods does not cause alarm in the knowledge that the art of handling and treating timber is thus wisely developed and improved to the end that relatively inferior woods are made to give equal and even superior service and economy."

Of special interest were addresses on The Diversity of Use of Treated Timber on the Santa Fe, by R. S. Belcher; Twenty-One Years' Experience with Treated Ties on the Lehigh Valley, by C. B. Musselman, chief treating inspector on the L. V.; and The Use of Treated Timber in Construction, by F. O. Dufour, consulting engineer, United Engineers and Constructors, Inc. Mr. Musselman's paper is abstracted on a following page, while abstracts of Mr. Dufour's and Mr. Belcher's papers will appear in later issues.

A report that aroused special interest was presented by the Preservatives committee on the high-residue creosote oils that are giving rise to serious concern on certain roads which are using creosote-petroleum and

creosote-coal-tar mixtures. This report traced the changes that have occurred in creosote oil as the proportion of domestic production has increased and indicated that exhaustive studies will be undertaken to ascertain the relation between the oils used heretofore and the service life secured from timber so treated. Believing that high-residue oils are less toxic, several roads have recently introduced into their specifications provisions restricting this residue. The proposed study is to determine the necessity for this action.

A mathematical approach to the problem of determining the relation of the characteristics of coal-tar creosote and coal-tar products (proportions of high-volatile constituents) to their effectiveness as preservatives, was offered in a paper by Ernest Bateman, senior chemist, Forest Products Laboratory. The results were qualitative rather than quantitative, but demonstrate clearly that three factors must be considered in judging of the effectiveness of treatment, namely, the quality of the creosote, the quantity used or extent of absorption, and the nature of the exposure. They demonstrate, further, that if the quantity injected is large, the character of the creosote is of less consequence, provided one is certain that it is a coal-tar creosote.

The report of the Committee on the Processing of Wood, headed by A. W. Armstrong, president, Ayer & Lord Tie Company, dealt primarily with the fire-proofing of wood. As a result of investigations indicating that many problems in this field still remain to be solved, the committee, on June 10, 1930, recommended to the Executive committee of the association the initiation of a general research in this field. Plans for financing this undertaking are now being considered in collaboration with the National Lumber Manufacturers' Association.

### Testing Chemicals For Fireproofing Properties

The subject of fireproofing was covered also in a report prepared by G. M. Hunt, T. R. Truax and C. A. Harrison of the U. S. Forest Products Laboratory, on experiments conducted with 33 different chemicals on specimens of southern yellow short-leaf pine. Of the chemicals employed, approximately 20 were reported to show distinct effectiveness in reducing the tendency of wood to flame as well as in reducing the building up of temperatures, while other chemicals increased the rate of burning or had no important retarding effect. A few were distinctly effective, even when present in the wood in comparatively small amounts. The chemicals varied in their influence on the apparent moisture content of the wood, which is a factor in fire resistance. Intensive studies were made to show the relation between absorption and effectiveness of ammonium chloride, ammonium sulphate, mono-ammonium phosphate and borax, using various absorptions up to 20 per cent or more of the weight of the wood. Comparisons were made with diammonium phosphate and zinc chloride for which similar test data are available. Thus far, none of the chemicals studied intensively has shown superiority in effectiveness to diammonium phosphate, but monoammonium phosphate closely approaches diammonium phosphate in effectiveness.

### Bridge and Structural Timber

A committee, of which G. A. Haggander, bridge engineer, Chicago, Burlington & Quincy, was chairman, outlined a program for the compiling of data on the service life of treated wooden bridges and similar structures. It also submitted instructions for the handling of treated bridge material in the field as follows:

It is recommended that in so far as practicable, treated timbers and piling shall be framed and bored before treatment and field work of this character limited to a minimum.

The use of cant hooks, pickaroons, peavies and other pointed tools, excepting end hooks, shall not be allowed in the handling of treated timbers and piling by field crews. The greatest care shall be exercised in the unloading and handling of treated timbers and piling so as not to expose the untreated wood.

Treated timber and piling shall not be bored, or cut in the field if avoidable.

All treated timber and piling which must be cut or bored after treatment shall have the surfaces so exposed, covered with hot creosote. Where cut, the surfaces shall be painted thoroughly with two coats of hot creosote, followed by the application of a heavy coat of asphalt or pitch. Where holes are bored they shall be poured full of hot creosote.

Horizontal holes, such as those for sway-brace bolts, may be filled by pouring hot creosote into them through a bent funnel. The use of equipment to apply hot creosote oil under pressure in holes bored in the field is recommended. Holes shall not be bored nor spikes driven in piles to support scaffolding. Where holes have been bored in piles or timber and are not used for bolts, the holes shall not be left open but shall be poured full of hot creosote and a tight treated plug inserted.

In the Operating Room of the Green Spring Treating Plant of the Baltimore & Ohio

Ends of treated ties must not be cut off to secure perfect alinement.

Treated piles must not be cut for sway bracing. Piles of uniform size shall be selected for each bent and, in case of necessity, treated filler blocks shall be used to fill out between piles or caps and sway bracing.

Water tables shall not be cut on tops of piles, but piles shall be left square cut. After thoroughly painting the tops with two coats of hot creosote, followed by the application of a heavy coat of asphalt or pitch, a sheet of heavy roofing paper or a metallic cap shall be placed before placing the timber cap.

In case piles are driven and a preliminary cut off is made in advance of the time when it is expected to make the final cut off, the tops of the piles where the temporary cut-off is made shall be treated with at least one application of hot creosote oil.

## Report on Tie Service Records

The Committee on Tie Service Records, of which W. R. Goodwin, engineer of wood preservation, Minneapolis, St. Paul & Sault Ste. Marie, is chairman, presented an extension of its table of annual tie renewals on 27 representative roads. This table is presented in summarized form below. Tabular reports were presented also relative to test tie track sections on eight different railways. The subcommittee assigned the subject of abuse of ties after treatment reported investigations indicating that some unnecessary abuse is occurring and has under consideration recommended procedure for procuring maximum service.

**Tie Service Records**

| Road | Renewals per Mile of Track 1929 | Five Year Average |
|---|---|---|
| A. T. & S. F. | 165 | 135 |
| B. & O. | 152 | 177 |
| C. B. & Q. | 159 | 156 |
| C. & E. I. | 120 | 112 |
| C. C. C. & St. L. | 91 | 108 |
| C. M. St. P. & P. (Eastern lines) | 282 | 248 |
| C. R. I. & P. | 151 | 146 |
| D. L. & W. | 79 | 92 |
| G. N. | 212 | 209 |
| I. C. | 212 | 189 |
| K. C. S. | 152 | 141 |
| L. V. | 48 | 74 |
| M. C. | 102 | 135 |
| M.-K.-T. | 216 | 229 |
| C. I. & L. | 125 | 124 |
| N. Y. C. (East) | 140 | 158 |
| N. Y. C. (West) | 74 | 91 |
| N. P. | 146 | 152 |
| Penna. | 143 | 174 |
| M. St. P. & S. S. M. | 236 | 278 |
| S. P. (Atlantic System) | 206 | 224 |
| S. P. (Pacific System) | 191 | 217 |
| U. P. | 150 | 186 |
| C. R. R. of N. J. | 79 | 86 |
| Reading | 135 | 161 |
| M. P. | 260 | 274 |
| C. & O. | 183 | 249 |
| Average—27 railways | 170 | 180 |

## Abuse of Treated Posts

The Committee on Posts, of which Frank McCrory, chief tie inspector, Chicago, Rock Island & Pacific, was chairman, presented a brief report from which the following is abstracted with respect to the abuse of posts after treatment.

In handling and storing posts after treatment they should not be bruised and should be placed in such a manner that they will lie as close together as possible. This will tend to keep the leaching of preservatives at a minimum and will also lessen the fire hazard.

Treated posts should not be driven into the ground. This is the easy thing for section forces to do when making repairs, and especially when replacing a single post. This damages the top of the post, destroys the treatment and shortens its life. Excessive hammering of the posts in driving staples has the same effect, although to a less extent.

After posts are installed, heavy growth of vegetation should not be allowed to accumulate around them. The ordinary grass fire has little or no damaging effect, but if an unusual amount of dry vegetation is allowed to accumulate around posts, damage will result.

The report also included two statements as to the resistance of treated posts to injury from grass fires, from one of which the following is quoted:

From my personal observation, which covers several years as a roadmaster, and from information I have been able to gather from our division engineer and roadmasters, we have no record of any damage to treated posts on account of right-of-way fires, even though it is our custom to burn our right-of-way every year.

## Marine Piling Experiments

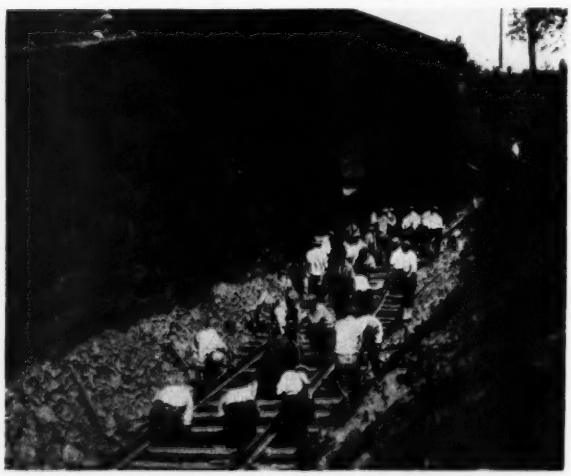
J. D. MacLean, senior engineer, Forest Products Laboratory, Madison, Wis., presented a paper on experiments which have been in progress since 1911 on the effect of various preservatives and treatments in increasing the resistance of woods to attack by marine borers. The work consists largely of tests carried on in Gulf waters in co-operation with the Louisville & Nashville and the Gulf & Ship Island. An abstract of Mr. MacLean's conclusions follows:

Very often those who are unfamiliar with the marine borer problem will draw conclusions from short time tests which later results prove to be unjustified. Even four or five years exposure to borer attack is not a sufficient length of time to demonstrate the merits of a given preservative.

In these experiments the higher boiling creosote oils and creosote fractions, the higher boiling water-gas-tar creosotes, and the mixtures of coal tar creosote and coal tar have given the best results, considering the absorptions obtained. Results obtained in these tests, as well as general experience, have demonstrated the importance of heavy absorptions and indicate that, from the standpoint of economy, timbers exposed under severe conditions, such as are found in a large portion of our coastal region, should be treated to refusal by the full-cell process. Heavy absorptions not only provide a reserve supply of creosote to compensate for leaching over a considerable period, but also insure deeper and more uniform penetrations.

It has been observed that, in general, borer attack in piling in service will start first in the region of least penetration. When borers have once gained access to the interior, even if it is through a very small opening, destruction usually occurs in a relatively short time.

The experiments show very definitely that limnoria can attack creosoted wood that effectively resists shipworm attack. Even heavily creosoted wood is not immune to limnoria.



**Lowering a Track to Get Greater Headroom.**

# The Lehigh Valley's Tie-Treating Policy After 21 Years*

## Size, inspection, handling, preservation and pre-boring reflect long experience

By C. B. MUSSELMAN

Chief Treating Inspector, Lehigh Valley, Bound Brook, N. J.

IN 1909 the Lehigh Valley signed a contract with a wood preserving company for the preservative treatment of its track ties, switch timbers, bridge ties and other forest products. This contract stipulated that creosote oil of acceptable quality and conforming with the specifications and requirements of the railroad should be used in the treatment. The contract was amended by an agreement in 1919 which permitted the use of a creosote-tar solution.

During the period from 1909 to 1919, straight creosote oil was used in the treatment of all ties, timbers, piling, etc. The greater part of the oil came from Europe, principally from England and Belgium. From 1919 to 1924 a solution of 80 per cent Grade 1 creosote oil, and 20 per cent coke-oven coal tar was used in the treatment of all ties, switch timbers and some construction lumber. Our piling and bridge ties were treated with straight creosote oil. From 1924 to the present time we have used a solution of 70 per cent Grade 1 creosote oil and 30 per cent coal tar in the treatment of the major portion of our ties, switch timbers, bridge ties and other lumber. For our oak and pine piles we use a solution of 85 per cent creosote and 15 per cent tar for the oak and an 80-20 solution for the pine.

### Other Factors Involved

We have learned by experience that there are several important factors other than the preservative treatment that enter into the question of the service expected and obtained from treated ties and other treated timber. It is not fair to expect to get 100 per cent life from ties that are not in a 100 per cent condition at the time of treatment. If the inspection of the untreated ties is slack, no treatment or preservative will correct this fault. Treated rotten ties may have all the outward appearances of first-class treated ties, when as a matter of fact, at least half of the years of expected service has been destroyed by decay. During this 21-year period, we have maintained a high standard of inspection and will continue to do so.

We consider the tie and timber inspector a person of no small importance and we believe that he holds the first line of defense. On the other hand it has been our experience that it is of little value to have good inspectors and insist that they do a 100 per cent job if the inspected ties are not properly handled and cared for. It is not good practice to leave ties piled along the right-of-way for any great length of time after they are inspected. We make it a practice to inspect all right-of-way ties very soon after they are delivered and insist that they be loaded and shipped to the treating plant on the day of inspection or within a week thereafter. This leaves no excuse on the part of the treating engineer for the treatment of decayed ties insofar as the time they are held away from the treating plant after inspection is concerned.

### What Kind of Wood?

During the time we have been using treated ties, we have tried to base and regulate our purchases as to the kind and size, on the results obtained from treated ties in service, and today we are buying only mixed oak and pine ties. We found that blight-killed chestnut did not produce a tie that would give the expected service; that hemlock ties did not take treatment readily; that ash and hickory ties checked and split badly both before and after treatment; and that the service obtained from such hardwoods as beech, birch and maple did not average up to that obtained from ties made from mixed oak and sap pine.

With these facts at hand and considering the greatly reduced number of ties required per mile for proper track maintenance, we believe we are justified in limiting our present purchases to ties of oak and pine. By doing this we expect further to increase the years of service above the average we are now getting from our treated ties.

We also place a limit on the size purchased. At present on an order for main-track 7-in. by 9-in. and 7-in. by 8-in. by 8-ft. 6-in. ties, we accept only 15 per cent of the 7-in. by 8-in. ties, and for side track and yard work requiring 6-in. by 8-in. and 6-in. by 7-in. ties, we accept only 15 per cent of the 6-in. by 7-in. ties.

All of the material treated for the Lehigh Valley since 1909 has been air seasoned. We have followed no set rule in regard to this but always try to get our material treated when in our judgment it is ready and fit for treatment. We have found that the time required for the proper air seasoning of ties and timber varies greatly with the location of the storage yards and the kind of weather prevailing during the seasoning periods. We have experienced one or two very wet summers during which it was necessary to treat some ties that were not properly air seasoned, in order to protect them from deterioration through decay. We have noticed that such ties are not giving as good service as do ties from the same sort of wood that were properly air seasoned before treatment, owing to the fact that they check to a depth greater than the penetration of the preservative

*From a paper presented before the annual meeting of the Wood Preservers' Association at Philadelphia, Pa., on January 28.

after being placed in service. This we found to be especially true of beech, birch and maple ties.

We endeavor to use the amount of preservative that seems to offer the proper protection from decay, and to a certain extent we base the quantity of preservative on the expected years of service. In many cases we treat both ties and other materials to refusal.

### Many Factors Affect Life of Ties

Properly treated ties improperly applied and maintained will not and should not be expected to give their full value in years of service. Tie plates, tie plugs, the weight and condition of the rails, the kind of rail fastenings and the weight and condition of the rolling equipment all enter into the question of service obtained from ties and other track materials. In other words, the service life obtained from treated ties is controlled to a great extent by the other track materials and by the track maintenance methods. There is no question but that the track structure must keep in step both as to size and quality with the advances made in transportation equipment.

During the last 21 years we have made many changes in the strength of our track, and have made many improvements in our methods of track maintenance. In addition to using ties that average larger in size, since 1914 we have been using 20 ties to each 33-ft. rail as compared with 18 previous to that time.

The weight of rail in general use in our main tracks from 1900 to 1911 was 90 lb. and the splice bars were 26 and 28 in. long. The new rail placed from 1911 to 1916 was 110 lb. on curved track and 100 lb. on tangent track, with a 26-in. splice bar. Early in 1916 the 136-lb. rail was adopted for use on main tracks and this weight of rail has continued in use to the present. The splice bars first used on the 136-in. rail were a 25-in. continuous bar and a 26-in. ordinary bar. During 1929 we adopted a 38-in. splice bar for use with the 136-lb. rail.

In 1914 we were using an 8-in. by 9½-in. by ½-in. tie plate and in 1920 we changed to an 8-in. by 10-in. by ½-in. plate. In 1925 we adopted as standard for use under the 136-lb. rail a canted double-shoulder plate, 8 in. by 13½ in. by 29/32 in. which is in use at present. In 1927 we put in service under the 100 and 110-lb. rail a canted plate, 7 in. by 10⅜ in. by ¾ in. The switch plates have been changed in type and increased in size from time to time. Rail anchors are extensively used on all of the main tracks.

### Adzing and Boring

For a number of years the demand for ties was met entirely by local purchases along the right-of-way. Over 90 per cent of these ties were sawed and for that reason we had little use for any tie-adzing equipment. Owing to the rapid changes and variety of sizes of tie plates and rail in use, we were of the opinion that pre-boring the ties had little if any value from a track maintenance point of view. We are well aware of the fact that pre-boring does have a great value in so far as treatment is concerned.

As we are now limiting our purchases to mixed oak and pine ties, the major part of which are purchased in the open market and are over 90 per cent hand hewed, we have installed adzing and boring equipment and are adzing and boring all of our ties before treatment.

During the period from 1910 to 1930 inclusive, we treated various kinds of ties and timbers in the amounts shown in the table, all of which were furnished under our own purchase and inspection.

**Material Treated from 1910 to 1930**

| | |
|---|---|
| Southern pine (sap pine) | 5,771,261 |
| Hardwoods (mostly beech, birch and maple) | 1,125,160 |
| Oaks (red, white, chestnut, etc.) | 1,691,506 |
| Chestnut | 101,934 |
| Hemlock | 11,655 |
| Ash | 8,021 |
| Tamarack (Canadian) | 1,600 |
| Total | 8,711,137 |
| During the same period we treated the following: | Feet, b.m. |
| Switch ties, all 7 in. by 10 in.— | |
| Southern pine | 20,812,322 |
| Southern oak | 3,785,268 |
| Beech and maple | 21,465 |
| Total | 24,619,055 |
| Bridge ties and other lumber—pine and oak (mostly pine) | 21,464,857 |
| Paving blocks | 25,889 |
| Oak and pine car lumber | 197,067 |
| Total | 21,687,813 |
| Oak and pine piling (mostly oak) | 2,996,254 |
| Oak tunnel ties | 393,220 |
| Grand total | 49,696,342 |

### Reduction in Tie Renewals

During 1910 the total tie renewals per mile of track on the Lehigh Valley amounted to 177. The tracks in that year were laid with as good a grade of untreated ties of white oak, rock oak, live chestnut and southern heart pine as was then obtainable. However, from 1910 the crosstie renewals per mile of track grew steadily in number, reaching a requirement of 289 ties in 1915. In the years following 1915 and up until 1929 there was a steady decline in the number of ties used per mile, reaching the unusually low figure of 48 in 1929 and the relatively low figure of about 58 ties per mile for the year just ended. To put it in other words, the tie renewals in 1929 were about 27 per cent of the 1910 requirements and about 17 per cent of those of the peak year 1915. The renewals for the year just ended were slightly under 20 per cent of the 1915 requirements.

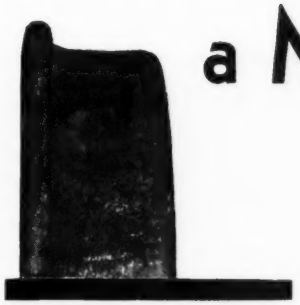
The experience of the Lehigh Valley is corroborative of the economic value of timber preservation. In the first place, the great reduction in the number of ties required for the yearly renewals has made it possible to make a like reduction in the number of treated and untreated ties carried in stock. In our case, the stock of treated ties has been reduced about 200,000 ties.

It can readily be seen that the cost of labor to install 48 ties per mile should not be much more than 17 per cent of the cost of placing 289 ties, and for 58 ties per mile it should be about 20 per cent of the 1915 cost.

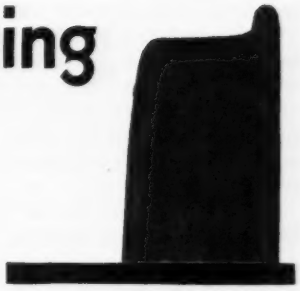
Also the installation of new ties in rock, sand, cinder or gravel-ballasted tracks always means more or less follow-up work to get and keep the tracks in a first-class condition. The amount of roadbed disturbed per mile of track, based on the use of 3,000 ties per mile, is about 9.6 per cent for the installation of 289 ties, as against 1.6 per cent for the installation of 48 to 58 ties per mile. The use of treated ties, therefore, reduces the cost of track maintenance from that angle.

The following results show what we have obtained from the use of treated ties and timbers, coupled with improved labor-saving apparatus and improved methods of track maintenance. In 1918 the man-hours required for maintenance work were 11,629,549; in 1928, 5,675,-413; and in 1929, 5,590,042, while the man-hours for 1930 will be under the 1929 figure.

# How to Keep a Motor Car Running



**The care of wheels, axles and brakes » » Motor-car shops and maintenance » » Rules*†**



Two Examples of Worn Wheel Treads

By C. R. KNOWLES ‡

IT IS extremely important that wheels be maintained properly, for their condition affects both the safety and efficiency of the car. Common defects in wheels are loose rivets, sharp flanges caused by excessive wear, cracks or seams in the face of the tire and worn bearings on the loose wheels. Nearly all repairs and renewals to motor car wheels can be performed in the field.

The principal reason for the renewal of motor-car wheels is wear on the tread and face of the flange. Care should be exercised to maintain proper gage and alinement in order that the wear shall be uniform and the maximum life secured from the wheels.

It is apparent from the condition of many motor-car wheels in service and the frequent accidents which result from worn wheels, that the average motor-car operator either does not appreciate the importance of checking the wear on wheels or is unable to do so without a gage. While excessive or unusual wear on wheels should be readily detected by an experienced eye, a standard tire gage is the only accurate and reliable method by which the actual amount of wear can be determined, and a gage should be used in every case where there is any doubt as to the condition of the wheel.

A certain amount of care and good judgment is necessary even with the use of a tire gage on account of the differences in the contour of the treads and flanges of motor-car wheels, particularly the flanges. Some treads are straight while others taper and the height of the flange varies. Therefore the detection of wear on tires and flanges requires either a selected number of gages to fit each particular type of wheel in service or frequent careful inspection by someone competent to detect unusual wear without the aid of the gage.

Care should be used in removing tight wheels from axles. The driving of the axle out of a wheel with a sledge hammer should be avoided wherever possible and wheel pullers used instead. In applying new wheels care should be exercised to see that the hub is properly bored to fit the axle and that the proper gage is maintained. While practically all of the motor-car manufacturers maintain the same taper, the position and length of hub vary.

In replacing insulated wheels, care should be exercised to see that the fiber insulation is of the proper dimensions, making allowance for the draw on tapered axles. If the insulation is too thick, it may result in wide gage, a bursted wheel hub, or a broken or damaged axle, while if it is too thin the gage will be too narrow and the wheels will probably cramp the frame of the car. Loose wheels, either bushed or plain, should be fitted snugly to the axle with as little lost motion as possible, and either the bushing or the wheel replaced when excessive wear occurs.

Demountable tires can be renewed readily in the field as it is only necessary to remove a certain number of bolts. Care should be exercised in replacing tires on wood-center wheels. An old tire should be removed by sawing it in two at one or more points. The wood filler of the wheel should be kept intact and the new tire should be heated to expand it sufficiently to allow it to go into place without excessive driving. It is sometimes necessary to shim the wood filler or felloe of the wheel to obtain perfect roundness.

In every case where wheels or axles are disturbed, they should be properly adjusted to line and gage. Wheels may be properly trammed by taking careful measurements between axle centers while the alinement may be established by the lateral adjustment of the thrust collars on the axles.

## Axles

It is frequently necessary to renew axles in the field because of their being either bent or worn. Roller or sleeve-type bearings are coming into almost universal use and it is necessary to remove the wheels when either type of bearing is in use. In replacing axles, it is desirable that they come completely fitted with wheels because of the fact that in replacing old wheels on a new axle it is frequently difficult to maintain the required gage. The diameter of the axle at the point of bearing should be checked carefully to make sure that it is of the proper size to receive the new bearing. If the old

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*This is the thirteenth of a series of 15 or more articles on the Care and Operation of Motor Cars, the first of which, on the Place of the Motor Car in Railway Work, appeared in January, 1930, page 5; the second on the Type of Motor Car, in the February issue, page 54; the third, on the Motor-Car Engine, in the April issue, page 158; the fourth on How a Motor Car is Built, in the May issue, page 214; the fifth, on Proper Lubrication, in the June issue, page 248; the sixth on Ignition, in the July issue, page 295; the seventh, on the Care of Motor Cars, in the August issue, page 339; the eighth, on How to Secure Efficient Operation from a Motor Car, in the September issue, page 376; the ninth, on Motor Car Accidents, in the October issue, page 416; the tenth, on Motor Car Accidents, in the November issue, page 482; the eleventh, on Operating Motor Cars Safely, in the December Issue, page 546; and the twelfth, on How to Keep a Motor Car Running, in the January issue, page 44.

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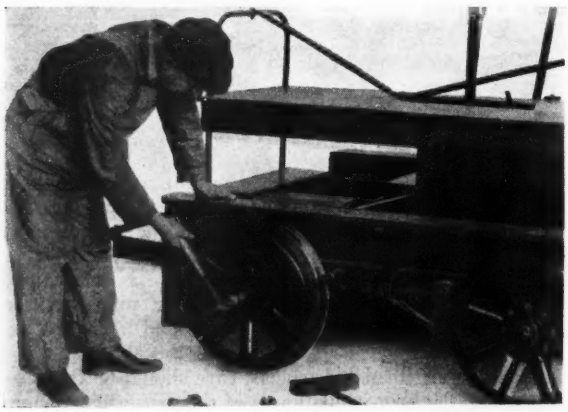
‡Mr. Knowles is in charge of the operation and maintenance of motor cars and other gasoline-operated work equipment on the Illinois Central System.

bearings are replaced on a new axle, the rollers or balls should be taken out and inspected to see that there are no flat surfaces, and the casing should be thoroughly cleaned to remove any dirt or other foreign matter. On plain bearings, the brasses, pedestals and cellars may be removed or replaced without disturbing the wheels.

Frame and deck members of either wood or steel may be replaced in the field where they are fastened together with bolts. If the frame and deck construction is riveted or welded it is advisable to perform this work in the repair shop where the repairman may have access to an acetylene torch and means of heating and replacing rivets.

Rotted or broken boards in the deck or frame should be replaced promptly to avoid possible accidents or other damage. Tool trays, battery boxes and seats should be kept in good condition. Bolts and joints in safety railings should be examined frequently and any loose bolts or joints tightened when they become loose.



**Removing a Wheel with a Wheel Puller of the "Shock" Type—Wheels Should Not be Removed with a Sledge Hammer.**

The frame and deck should be kept clean and should be painted the standard color. This painting can be done in the field by the operator at a nominal expense.

Standard construction or the original design of the frame, deck, housing, etc., should be rigidly adhered to, and any repairs that are made in the shop or in the field should follow existing standards. The addition of extra seats and tool boxes, other than original equipment, on motor cars should be avoided.

## Brakes

The safety of a car depends very largely on the efficiency of the brakes, and they should be maintained in first-class condition at all times. Modern motor cars are equipped with four-wheel brakes which are readily adjustable. With the older types it is sometimes necessary to make adjustments by either placing a liner on the brake shoe or by renewing the shoe itself. Liners of rubber or leather on brake shoes are not objectionable but care should be exercised in attaching them to the shoe to see that nails are placed in such a manner that they will not come in contact with the wheel and destroy the braking effect. Shoes should have a full bearing on the wheels. Where a brake band and drum are used, the band should be so adjusted that it will just clear the drum on the lower side and will not drag on the top of the drum. Any lost motion in the levers, toggles, joints and pins of the brake rigging should be corrected immediately. It is rarely necessary to shop a car for the repair or renewal of the brake equipment as such repairs can be made in the field quite as readily as in the shop, and in the interest of safety should be handled by the operator as he is in a position to make immediate repairs without withdrawing the car from service.

## Motor Car Shops

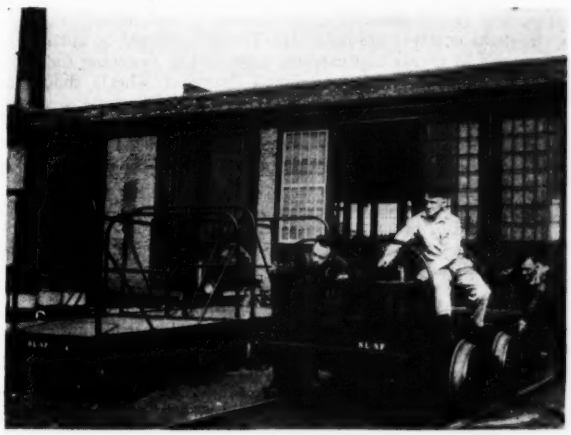
While it is highly desirable that light repairs and the replacement of parts of motor cars be made in the field, it is also desirable that heavy repairs and general overhauling be done at points where proper facilities are available to do such work efficiently. The conduct of heavy repair work in a centrally located repair shop has advantages over the making of such repairs in the field if the shop is provided with the proper facilities and competent workmen. Among the advantages of a motor-car shop are the centralization of the stock of repair parts and the elimination of the travel time necessary for field work; the disadvantages are the cost of transporting cars to the shop and the loss of time while the cars are out of service for repairs. The advantages of making repairs at a central point, where all the necessary machines, tools and proper equipment are available to handle the work promptly and economically, outweigh the advantages of making such repairs in the field, provided the cars are shipped in only when the repairs required are heavy.

Motor-car repair shops are necessary for the complete overhauling of motor cars and engines. These shops should be wholly under the supervision of the maintenance of way department, and, following the recommendation of the American Railway Engineering Association, in no case should the repairs be done by or under the direct supervision of the mechanical forces as the men who are engaged in repairing locomotives and cars are not familiar with the types of machinery and equipment used in the construction of motor cars, and the repair of such equipment calls for men especially trained in the maintenance of internal combustion engines, and automotive and electrical equipment. Also, forces charged primarily with the maintenance of revenue-earning equipment naturally can not be expected to show the same interest in maintenance of way equipment as an organization charged specifically with its repair and operation. It is recognized that under some conditions it may be desirable to combine certain features of the work but in almost every case a separate organization can be justified and, with the great increase in labor saving equipment of various kinds on our railroads, there is usually sufficient work on even the smallest railroad to justify some sort of an organization for the handling of repairs to motor cars and other maintenance of way equipment.

**View of a Motor Car and Work Equipment Shop.**

No set rule can be established to determine the number or location of shops, for the problem of motor-car maintenance differs with each railroad. The number and the variety of types and kinds of cars in service will have a great deal to do with the maintenance policy followed. For example, a large southern road is almost entirely equipped with one make of car, which makes it feasible to operate a central shop for the maintaining of all cars on the system, while another railroad operating under similar conditions has 9 different makes of cars and 22 different types, which increases the difficulty of centralizing repairs.

It is, of course, desirable to have as few shops as possible, centrally located. Two opposed problems are involved in the location of motor car shops, first, centralization with long haul and delay in transporting motor



A Motor Car Being Tested After Leaving the Shop.

cars to and from the shop for repairs and, second, decentralization with a duplication of machinery and equipment and possible loss of efficiency and economy through the necessity for employing specialized labor at additional shops. Where a large amount of work equipment other than motor cars is handled in the repair shop and where traveling motor-car maintainers are employed, motor-car shops may be located on each grand division, or even one centrally located system shop may be ample. As a rule, however, where roads are completely equipped with motor cars there are a sufficient number of cars to justify a motor-car repair shop on each division. It is desirable to locate these shops as centrally as possible in order to avoid excessive haul of the cars or other equipment. Other factors are the location of storehouses, reclamation plants and division offices.

## Tool Equipment For a Shop

A list of tools and appliances to equip a motor-car shop completely, as recommended by the Special Committee on Maintenance of Way Work Equipment of the American Railway Engineering Association, follows:

Wood Working Machine
- 1 Combination woodworking machine with 12-in. jointer, band saw complete, shaper complete, saw table with 12-in. saw, and wood-boring attachment complete. Machine to be equipped with guards on saw table, band saw, and shaper.

Metal Working Machine
- 1 Lathe 24-in. by 72-in. with quick-change gears, complete with reversible motor, chuck, tool assortment, and tool post grinder.
- 1 20-in. back geared upright power drill, motor driven. Chuck to handle No. 4 taper shanks, drill sizes up to 1½ in.
- 1 Two-stage stationary air compressor with motor complete.
- 1 Plain trolley of 2000-lb. capacity, and 40 to 60 ft. of 12.25-lb. 6-in. I-beam with necessary fittings, such as clip hangers for supporting I-beam to ceiling or truss beams.
- 1 Wheel press, capacity 35 tons.
- 1 One-tone chain hoist, screw or differential gear.
- 1 Grinder, floor type with pedestal, with built-in motor, size of grinding wheels 2-in. by 12-in. (1 coarse, 1 fine).
- 1 Standard ½-in. portable electric drill.
- 1 Drill stand, bench type, to be used with portable electric drill.

Painting and Cleaning Equipment
- 1 Spray equipment outfit for painting and cleaning motor cars and machinery; paint gun, two-quart size, with hose and fittings, and combination grease and water extractor with gages; this outfit to be used with stationary air compressor.

Blacksmith Tools
- 1 Cast-iron hearth forge with half hood, 23 in. by 35 in.
- 1 Solid steel anvil.
- 1 6-in. blacksmith vise.
- 1 Set of swedges, swedge blocks, punches, cold and hot chisels, tongs, etc.

General Mechanical Tools
- 1 6-in. combination swivel-base vise.
- 1 3-in. combination swivel-base vise.
- 1 Set pipe stocks and dies, ⅛ in. to 1 in.
- 1 Set bolt dies and taps, ¼ in. to ¾ in.
- 1 Set expansion reamers, ½ in. to 2¼ in.
- 1 Set solid taper reamers, 1¼ in., 1½ in., 1¾ in.; taper ¾ in. to 1 in.
- 1 Acetylene welding set.
- 1 Set inside micrometers, 2 in. to 5 in.
- 1 Set outside micrometers, 2 in. to 5 in.
- 1 Gasoline soldering furnace with soldering irons.
- 1 Special socket wrench set.

## Hand Tools For Motor-Car Mechanics

The following hand tools required by motor-car carpenters and repairmen, are suitable for either shop or field work and should preferably be the personal property of the man by whom they are used. (American Railway Engineering Association recommendation).

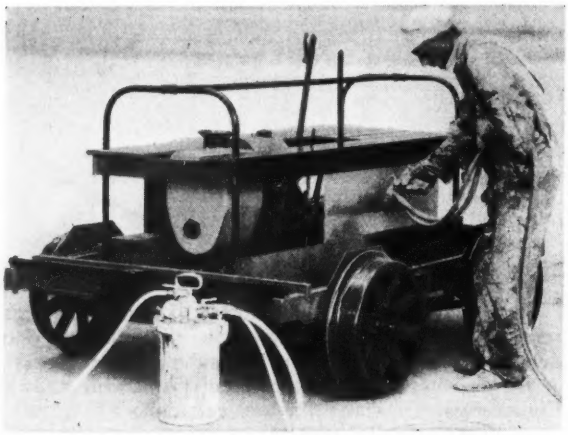
Motor-Car Carpenter's Tools (personal).
- 1 No. 11 Saw.
- 1 No. 8 Saw.
- 1 Framing square.
- 1 6-in. try-square.
- 1 Stanley odd-job tool.
- 1 10-in. carpenter's brace.
- 1 Set wood bits, 7/16 in. to 1 in.
- 4 Ship augers, ½ in., ¾ in., ⅞ in. and 1 in.
- 1 Expansive bit, ⅞ in. to 3 in.
- 1 Ratchet screw driver.
- 1 Screw-driver bit for brace.
- 1 Jack plane.
- 1 Smoothing plane.
- 1 Drawing knife, 16 in.
- 1 Combination carborundum stone, 1 in. by 2 in. by 8 in.
- 1 Carpenter's claw hammer.
- 1 Hand axe.
- 1 Set nail sets.
- 1 Level.
- 1 Plumb bob.
- 1 Straight edge.

Motor-Car Repairman's Tools (personal).
- 1 No. 33 Double-head, open-end wrench, 15-deg. angle.
- 1 No. 38 Double-head, open-end wrench, 15-deg. angle.
- 1 No. 40 Double-head, open-end wrench, 15-deg. angle.
- 1 No. 661 Set-screw wrench.
- 1 6-in. Monkey wrench.
- 1 12-in. Monkey wrench.
- 1 Set socket wrenches, 1 3/16 in. to 1 7/32 in.
- 1 Carpenter's brace, 8 in.
- 1 Set wood bits, 7/16 in. to 1 in.
- 1 10-in. Stillson wrench.
- 1 18-in. Stillson wrench.
- 1 24-in. Stillson wrench.
- 1 Hand saw, No. 9.
- 1 Framing square.
- 1 6-in. try-square.
- 1 Jack plane.
- 1 Set hand punches, 7/16 in., ¼ in., 7/16 in., ⅜ in.

1 Set center punches.
1 5-oz. ball pein hammer.
1 1½ lb. ball pein hammer.
1 Set bearing scrapers.
3 Screw drivers, 4 in., 8 in., 10 in.
1 Combination carborundum stone, 1 in. by 2 in. by 8 in.
1 No. 21 Double-head, open-end wrench, 15-deg. angle.
1 No. 23 Double-head, open-end wrench, 15-deg. angle.
1 No. 25 Double-head, open-end wrench, 15-deg. angle.
1 No. 27 Double-head, open-end wrench, 15-deg. angle.
1 No. 29 Double-head, open-end wrench, 15-deg. angle.
1 No. 31 Double-head, open-end wrench, 15-deg. angle.

### Tool Requirements Vary

In selecting tools and equipment a careful survey should be made of the actual requirements, for all of this equipment will not be required in every shop. For example, a 24-in. lathe might not be required in all shops. The same is true of a combination wood-working machine, although a machine of this kind can be justified



**A Paint Spray Outfit Is An Essential Part of the Motor-Car Shop Equipment.**

on almost any division as it is perhaps of greater value to the carpenter forces in framing lumber, sash and door work and other repairs and construction than it is in the construction of motor car decks, frames, etc. The force employed and the amount of work to be done will depend on the number of cars served by the shop and to a large extent on whether or not traveling motor-car maintainers are employed. So far as possible, work should be confined to cars requiring complete overhauling and cars damaged in accidents. Reclamation work can also be carried on where motor-car shops, for example system or grand-division shops, serve considerable territory and a large number of cars. Relieved cars should be shipped to the motor-car shop, dismantled, all usable parts reclaimed and the balance of the parts classified as scrap. As a rule no attempt should be made to manufacture parts in these motor-car shops, with the exception of parts for wood frames and certain minor parts, as repair parts can usually be purchased from the manufacturer, or in the open market, at prices much lower than they can be manufactured in such shops.

The following rules have been drafted as representing good practice in motor-car maintenance:

(88) The operator of a motor car should familiarize himself with all parts, detail adjustments and the lubrication of the car assigned to his care.

(89) The operator should make all repairs within his ability but should not attempt to make any repairs unless he is thoroughly familiar with what is to be done and how to do it.

(90) The operator should not tamper with the magneto or carburetor unless he is certain that it needs attention and that he is competent to make the required adjustments.

(91) No adjustments should be made to any part of the car or engine while the car is in motion, except the necessary regulation of the fuel and spark.

(92) Temporary repairs should be made only when necessary to keep the car in service; permanent repairs must be made as soon as possible.

(93) Only insulated wire should be used in replacing or repairing the wiring system. It should be of the proper size and kind for the purpose required. Worn insulation or splices in the wiring should be wound with tape.

(94) Gasoline tanks, fuel lines and connections should be inspected frequently to insure against leaks. A leak may be repaired in the field by soldering, but before putting a flame to the tank it must be emptied of gasoline and then filled with hot water at least twice to drive out all gasoline fumes.

(95) Belts should be kept reasonably tight at all times but the tension should not be excessive as it overloads the engine and causes friction. Care should be used in applying new belts or repairing old ones. The ends should be cut square and fit evenly and extreme care used in fastening the ends.

(96) The wear on the tread and flange of wheels should be watched carefully and wheels replaced when the wear becomes excessive.

(97) Wheels should be removed from axles with a wheel puller; they should never be driven off with a sledge hammer if it is possible to avoid it.

(98) In every case where wheels and axles are disturbed, they should be properly adjusted to line and gage.

(99) The motor car engine should be kept tight in its mounting at all times.

(100) In renewing the seats of leaky valves in four-cycle engines, they should be ground with flour emery or pumice stone to avoid loss of compression and possible destruction of valves and seats.

(101) Broken or worn cylinder rings should be replaced promptly to avoid loss of compression and poor operation of the engine. Broken or missing ring dowels should be replaced promptly to avoid damage to the cylinder.

(102) Sprocket wheels on chain drive cars should be kept in proper line; chains should not be allowed to run too tight or too loose; they should be cleaned and lubricated properly.

(103) Carbon deposits in the engine should be removed, as an excessive deposit of carbon becomes red hot during operation and ignites the charge before the piston has finished its compression stroke, resulting in a knock and loss of power. Loose carbon may also lead to the scoring of cylinders.

(104) In repairing or overhauling cars, standard construction should be strictly adhered to. The addition of extra seats and tool boxes on motor cars is prohibited.

**On the Chicago, Milwaukee, St. Paul & Pacific in the Bitter Root Mountains.**

# Plan Turnout Renewals Carefully

## Systematic preparation and conduct of work will greatly reduce delays to trains and yard switching

By R. S. WELCH
Division Engineer, Baltimore & Ohio, Cincinnati, Ohio

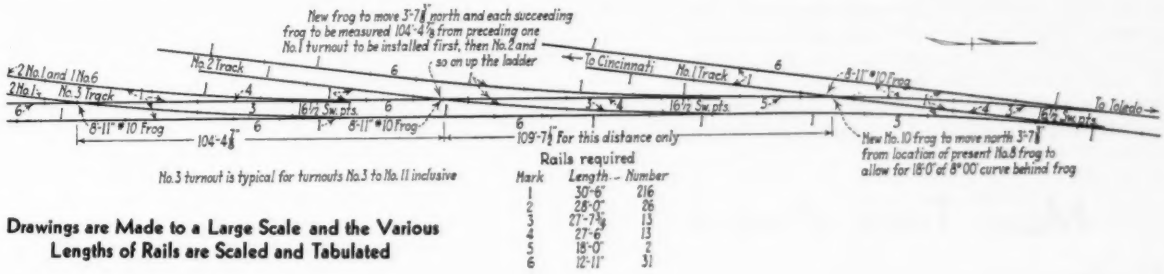
DELAYS to switching and other train operations in terminal yards of considerable traffic density are costly and for this reason any extensive program of turnout and ladder track renewals should be planned and systematized so that the actual time during which the tracks are removed from service is a minimum. In such a program full consideration should be given to such important factors as the selection and preparation of material, the organization of the gangs that are to do the work and, of course, the proper location of the turnouts and tracks. In this respect the practice followed in recent years on the Baltimore & Ohio may be of interest.

A large number of the yards on this road were built when engines were much smaller than they are now and 85-lb. rail and No. 7 and No. 8 frogs in ladders were entirely satisfactory. With the heavier and larger switching power now in general use, it has become necessary to use heavier material in track construction and to substitute No. 10 for No. 7 and No. 8 turnouts. Therefore, in addition to the problem of renewing the actual material in the ladder under traffic, we are also confronted with the problem of relocating the turnouts. There is certain to be some delay to yard switching while the ladder renewal is under way, but by careful planning and much preparatory work, this delay can be reduced considerably. The advantages to be gained are the practical elimination of derailments and the increased speed at which cars may be switched, which more than offset the slight interruption to yard switching while the work is actually in progress.

On account of variations in track centers and differences in frog angles, it is not possible to set up a standard that will fit all cases, although it is general practice to use No. 10 self-guarded frogs and standard 16½-ft. switch points. Good second-hand 100-lb. ARA-B rails, which are cut to exact lengths and drilled before being delivered to the job, are used. On the B. & O., the rails are cut and drilled at one of two centrally located rail-sawing plants.

The first step in the renewal of any ladder is to make an accurate survey of existing conditions and to plot them on a large scale, at least 20 ft. to an inch, and preferably 10 ft. to an inch. If the track centers are fairly uniform, say from 12 ft. to 13 ft., or from 12½ ft. to 13½ ft., it is advisable to average them and to use this mean throughout the ladder. This practice will permit the ladder to be constructed with equal distances between switches. The resulting slight throws on each track behind the frog will rarely be in excess of six inches and may be run out in short distances.

It is next necessary to determine the new location of any one of the several frogs in the ladder. If the ladder is on an angle greater than that of the frogs to be used, it is obvious that each turnout must be moved ahead a certain distance, which can be readily calculated. It is best to figure this distance for the first or last turnout in the ladder as the tracks connected to these usually remain unchanged, while the intermediate tracks are moved slightly to get average track centers. It is essential that the turnout to be renewed first shall be located accurately on the ground and either monumented or referenced, so that when the ladder is torn up, there will remain a fixed point at which to place the first frog or switch. The cumulative error should not average more than one-half inch per turnout.


New frog to move 3'-7⅛" north and each succeeding frog to be measured 104'-4⅛" from preceding one
No. 1 turnout to be installed first, then No. 2 and so on up the ladder
No. 2 Track
To Cincinnati
No. 1 Track
No. 3 Track
8-11" #10 Frog
16½' Sw. pts.
104'-4⅛"
109'-7⅛" for this distance only
To Toledo
New No. 10 frog to move north 3'-7⅛" from location of present No. 8 frog to allow for 18'0" of 8°00' curve behind frog

No. 3 turnout is typical for turnouts No. 3 to No. 11 inclusive

Rails required

| Mark | Length | Number |
|---|---|---|
| 1 | 30'-6" | 216 |
| 2 | 28'-0" | 26 |
| 3 | 27'-7⅛" | 13 |
| 4 | 27'-6" | 13 |
| 5 | 18'-0" | 2 |
| 6 | 12'-11" | 31 |

**Drawings are Made to a Large Scale and the Various Lengths of Rails are Scaled and Tabulated**

It has been found possible to use No. 10 frogs in a No. 7 ladder with track centers of 12 ft., providing the lead is shortened slightly and 13-ft. instead of 16½-ft. switch points are used. In this case, it is necessary to introduce a curve behind the frog, although the degree of the curve can be made practically the same as the turnout curve. The introduction of such a curve reduces the track capacity only slightly.

After the length of the leads has been determined and the distance between switch or frog points figured, as well as the distance that any frog shall be moved ahead, the various new turnouts are plotted on the large-scale drawing. If the track centers are the same, and frogs with equal angles are used throughout, the plotting of one or two turnouts will suffice, as the rails necessary for each will then be identical.

The next operation is to determine the length of each piece of rail required for a complete turnout, as well as for the ladder track. This can be done readily after a few trials, the length of the lead rails in the straight

side of the ladder being calculated, while the lengths of the other rails are scaled from the plan. It is advantageous to have as few different lengths as possible, as this facilitates cutting at the rail-sawing plant and requires less rail to be kept on hand for repairs. Each of the several lengths is given a number to identify it and the total number of rails of each length is tabulated. This information is given to the superintendent of the rail-sawing plant, who cuts the rails to the required lengths, drills, marks and ships them direct to the point of use. The longest length used is 30 ft. 6 in., which is the standard to which 33-ft. rails are cut on the B. & O. With an angle bar 27 in. long, it is only necessary to cut 15 in. from each end of the rail.

Although not essential, it is advisable to make a switch-tie layout, for, in view of the fact that little time is available for moving the ties about after the ladder is torn up, it will be of advantage to the foreman in locating the various lengths of ties properly. Much preliminary work can be done when renewing a ladder, if sufficient space is available adjacent to the ladder along which ties and other materials can be distributed directly opposite where they will be used. Sections of the continuous side of the ladder and lead rails and switch points can be coupled, and knuckle rails can be bent.

If the turnouts are moved, as is usually the case, it is necessary to move practically all of the switch ties and, rather than do this, it is more economical to remove all the old ties and renew them with a full set of new ties. Quite a number of these old ties are found suitable for further use and are assembled in sets and used in the back end of the ladder where switching movements are comparatively few as compared with the head end.

The number of turnouts that can be renewed in one operation depends on how long the ladder can be out of service, how much preliminary work can be done and the number of men available. Because of the greater amount of supervision, six or seven small gangs, each under a foreman, are better than one or two large gangs. Under good conditions, such gangs, with a total of about 40 men, should renew five turnouts in one day. This does not include the preliminary work or cleaning up, but merely removing the old turnout and placing the new.

# More Track Awards

IN addition to the accounts of the annual track awards on a number of roads which were presented in the December and January issues, pages 551 and 51, respectively, we give below the results of the track inspections on the Delaware & Hudson and the Baltimore & Ohio.

### 71 Prizes Awarded on Baltimore & Ohio

As a result of the annual track inspection on the Baltimore & Ohio for 1930, 71 cash prize awards, totaling $3,940 were awarded to supervisors and foremen for excellence in the physical condition of their sections or territories. Eighteen supervisors received prizes of $100 for the best districts on the various divisions; 19 foremen received prizes of $50 for the best main-line sections on the various divisions; 19 foremen received prizes of $35 for having sections on their respective divisions which showed the greatest improvement during the year; and 15 additional foremen were awarded prizes of $35 for having maintained the best branch-line sections on the various divisions.

Following is a list of the 18 supervisors who were awarded the $100 prizes for the best subdivisions during the year: E. C. Parks, Philadelphia division, Laurel, Md.; C. W. Selby, Baltimore division, Point of Rocks, Md.; C. Foltz, Cumberland division, (East End), Hancock, W. Va.; M. W. Laffey, Cumberland division, (West End), Piedmont, W. Va.; H. H. Tederick, Monongah division, Fairmont, W. Va.; J. E. Conley, Charleston division, Gassaway, W. Va., W. D. Lucas, Wheeling division, Wheeling, W. Va.; B. F. Hanna, Connellsville division, Rockwood, Pa.; J. W. Kimmins, Pittsburgh division, West Newton, Pa.; J. E. Weaver, Ohio division, Washington C. H., Ohio; B. C. Runyon, St. Louis-Indiana district, North Vernon, Ind.; B. O'Brien, St. Louis-Illinois district, Carlyle, Ill.; D. C. Purdy, Toledo division, Rossford, Ohio; F. Applegate, Indianapolis division, Springfield, Ill.; W. C. Hines, Newark division, Mansfield, Ohio; W. Carpenter, Chicago division, Garrett, Ind.; C. F. DeLong, New Castle division, Ravenna, Ohio; and C. C. Bierie, Cleveland division, New Philadelphia, Ohio.

### D. & H. Announces Track Prizes

Thirty-two prizes totaling $1,800 have been awarded on the Delaware & Hudson as a result of its annual track inspection for 1930, in which ratings were established for every roadmaster's, supervisor's and track foreman's territory. As in the past, the final ratings given to each territory were based on two main considerations; the physical condition of the various territories, determined by special inspection committees and a Hallade track recorder, and the efficiency with which the work for the year was carried out.

On the basis of adjusted ratings, the D. & H. made the following awards: First, second and third prizes of $50, $25 and $15, respectively, for the three best main line sections on the system; first, second and third prizes of $100, $75 and $35, respectively, for the three best branch line sections on the system; first, second and third prizes of $100, $60 and $35, respectively, for the three best-maintained sections on each of the four main divisions of the road; first, second and third prizes of $100, $75 and $35, respectively, for the three best first-class and three best second-class yards on the system; and first and second prizes of $50 and $25, respectively, for the two sections on each of the four divisions which showed the greatest physical improvement.

The foremen winning the first prizes in these various classifications are given in the following: For the best main-line section on the system, G. LeClair, Champlain division, Douglass, N. Y.; for the best branch-line section on the system, H. Deso, Champlain division, Peru, N. Y.; for the best main-line section on the Champlain division, G. LeClair, who also won the system prize; for the best main-line section on the Saratoga division, F. Parillo, Ballston, N. Y.; for the best main-line section on the Susquehanna division, F. Mazzarella, Sydney, N. Y.; for the best main-line section on the Pennsylvania division, L. Dillelo, Centre Village, N. Y. The first prizes for the best first and second-class yards on the system were won, respectively, by A. Powell, on the Susquehanna division, at Oneonta, N. Y., and T. Pasquarell, on the Susquehanna division, at Schenectady, N. Y. The first prizes on the divisions for the greatest improvement in sections were awarded to H. Deso, on the Champlain division, who also won the system branch-line prize; J. Corsall, on the Saratoga division, Lake George, N. Y.; C. Mahar, on the Susquehanna division, Seward, N. Y.; and N. Vendrone, on the Pennsylvania division, Scranton, Pa.

# WHAT'S THE ANSWER?

**Have you a question you would like to have someone answer?**
**Have you an answer to any of the questions listed here?**

## To Be Answered in the April Issue

1. *What are the causes of center-bound track? How can it be prevented? Are the causes or methods of prevention different with different kinds of ballast?*
2. *What precautions, if any, can be taken to insure that a suction line taking water from a stream will function properly during spring freshets?*
3. *After the frost is out of the ground and the track has settled, how long a period should be allowed for smoothing the line and surface before starting the season's program? What details of track maintenance should be given particular attention at this time?*
4. *What is the cause of the chalking of the paint film on both wood and steel structures? How can it be remedied?*
5. *What measures can section forces adopt to increase safety at highway crossings?*
6. *What is the most practical method of protecting deep-water cinder pits to prevent hostlers and others from falling into them?*
7. *What are the relative advantages and disadvantages of the spot and out-of-face methods of renewing ties?*
8. *What means can be employed to eliminate or minimize scouring below the outlet of culverts located along steep side hills?*

## Double Spiking

*Under what conditions, if any, should rails be double spiked? Should the double spiking be on the inside or the outside of the rail? Why* ?

### Double Spike Curves and Turnout Rails

By R. H. GILKEY

Division Engineer, Central of Georgia, Savannah, Ga.

It has been my experience that all main-track curves should be double spiked throughout. The only other situation where double spiking is required as a common practice is on the turnout rails at main line switches and such inside switches as are required to serve heavy train or switching movements. Occasionally, other turnouts, through which engines with long wheel bases must move, will require double spiking to keep them to gage.

The reason why double spiking is required is that there is a marked tendency for the gage to widen on curves. There is also an equally noticeable tendency on the part of both the high and low rails on curves to cant outward, even when heavy tie plates are used. Because of the latter, an inside spike offers greater resistance to the movement of the tie plate than one outside the rail, so that the extra spike should be inside the rail.

### Required on Curves of 3 Deg. or More

By J. A. SPURLOCK

Roadmaster, Missouri-Kansas-Texas, New Franklin, Mo.

My experience indicates that it is desirable to double spike all main-track curves of three degrees or more. This requires the use of six spikes to the tie. The extra two spikes should always be used on the inside of the rail and should be set in a slightly slanting position, which will bring the head, when fully driven, snugly against the back side of the spike hole in the tie plate. If driven in this manner, the spikes are much more effective in resisting the tendency of the rail to move outward than if they are driven to a tight fit against the base of the rail. This is particularly true with the combination pattern tie plates.

The double spiking of sharp curves is of great aid in holding them to proper gage. It thus reduces the frequency of regaging with the result that the life of the tie is definitely prolonged. Where shoulder tie plates are used, six spikes used in the manner described are as effective in holding the track to gage as eight would be, and the tie receives far less spike cutting. If the curves are spiraled, it is not necessary to double spike the spirals beyond the point where the curvature becomes less than three degrees.

### Would Spike the Outside Rail Only

By W. C. ROURK

Section Foreman, Texas & Pacific, Waskom, Texas

I am of the opinion that the high, or outer, rail should be double spiked on all curves of two degrees or sharper. In doing this it is preferable to do the double spiking on the inside of the rail. Experience has shown that there are three excellent reasons for this practice which is the most common method in use.

In the first place, the extra spike on the inside aids in the resistance which is needed to counteract the tendency of rails on curves to tip over. Second, there is less of the lateral pressure against the inside spikes that causes throat cutting in the outside spikes, so that spikes driven on the inside of the rail function longer and better. The third reason is that, since the greatest strain on the tie on a curve is just outside of the rail, it is better not to weaken it at this point more than is necessary.

My experience indicates that it is good practice to double spike the outer rail on turnouts from the heel of the point to the frog. I have also found it advisable

to double spike the main track rail ahead of the switch points. There is a decided thrust against this rail as the locomotives and cars emerge from the turnout, which is not entirely dissipated until the trucks have straightened up. In my opinion no great benefit is derived from double spiking the low rail on curves of moderate degree.

### Inside Spiking Is Most Effective

**By V. H. SHORE**

Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

Rails should always be double spiked at points where the thrust of the wheels is of sufficient magnitude to cause or tend to cause widening of the gage. This condition occurs with greatest frequency on the outer rails on curves and just ahead of the switch points at turnouts through which there are frequent movements.

The double spiking should invariably be done on the inside of the rail, if tie plates are in use. There are several reasons for this: Spikes driven on the inside of the rail have been found more effectively to hold the shoulder of the tie plate straight and snug against the base of the rail; this method eliminates almost entirely the throat cutting of the additional spikes which always gives so much trouble on the outside of curves and turnouts. The only condition under which double spiking is advisable on the outside of the rail is where tie plates are not used.

### Inside Spikes are Better Braced

**By G. W. EVANS**

Section Foreman, Missouri-Kansas-Texas, Elgin, Tex.

In this discussion it is assumed that shoulder tie plates are in service. Double spiking is indicated on well-maintained track wherever there is a marked tendency for the gage to widen from causes other than rail wear. This seldom occurs on tangent track, however, and usually not in sufficient degree to demand action on curves of less than three degrees.

Spikes driven inside the rail offer far greater resistance to the outward movement of the tie plate than those placed outside of the rail. The reason for this is that as soon as an incipient outward movement of the tie plate occurs, the spike and rail act mutually to form a brace against this movement. On the other hand, if the tie plate moves outward, the support which it offered originally to the outside spike is removed and as the rail presses against this spike the latter is bent over and ceases to function efficiently.

Bridgemen who line stringers on wooden trestles often use this principle to gain a support for the jacks used in lining. They do this by laying one spike on the cap, placing it parallel to the stringers, and then drive one or two spikes with their backs to the stringers until the heads catch firmly on the first spike. The amount of resistance which spikes driven in this manner offer to the pressure of the jacks is surprising.

### Extra Spikes Should Be Inside the Rail

**By W. H. SPARKS**

Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Before the era of tie plates it was a common practice to double spike curves. The minimum degree of curvature upon which this was permitted depended upon the physical condition of the roadbed, the amount and character of the traffic, the speed of trains and, frequently, upon the weight of the rail and the condition of the ties. At this time the extra spikes were always placed outside the rails, since an inside spike offered no resistance to the outward movement of the rail.

With the general adoption of the heavy-base shouldered tie plate, however, the conditions in this respect were changed radically. The minimum curvature for which double spiking is now required, has been raised considerably, and the position of the extra spikes, for greatest efficiency, has also been changed. The larger and heavier locomotives and cars and the higher average speeds that are maintained have tended to increase the thrust against the rails, which, to a marked extent, has counteracted the resistance of the tie plate. For this reason, even on the best maintained track, many curves show a tendency toward wider gage.

Experience indicates that in the usual form of track construction the most practical method to overcome this tendency of the rails to move outward and thus widen the gage, is to drive an extra spike inside the rail. It has been found that the extra spike, if driven inside the rail, offers greater resistance to the movement of the tie plate than a similar spike driven outside the rail.

## Classifying Scrap

*To what extent should the section forces be required to classify scrap before shipment* ?

### Separate Usable Material from Scrap

**By R. H. GILKEY**

Division Engineer, Central of Georgia, Savannah, Ga.

We do not require the section forces to classify scrap, but we do require the foreman to examine personally all scrap assembled on his section to insure that no usable material is included. We have scrap bins at all tool houses, in which a partition is provided. We require the scrap to be placed on one side of this partition and all usable material on the other side. These two classes of material are then loaded separately in the scrap cars to facilitate sorting at the general assembly yard.

### Complete Sorting Should Be Required

**By District Engineer**

In my opinion here is no reason why the section forces should not be required to make a complete classification of all scrap before shipment. With proper instruction, these forces are as well qualified to make the necessary separations as are the forces usually employed by the stores department for this purpose. Furthermore, the time required to make a complete classification is little, if any, more than is required to sort out the usable material from the scrap. The advantages of this method are that the cost of two handlings is eliminated; it is not necessary to ship the cars to the stores department, since they can be sold and billed to the purchaser from the point of loading, thus frequently saving long non-revenue hauls; while the cars are more quickly released for revenue service.

When the scrap is loaded without classification, except the separation of usable and unfit material, it must be shipped to the storehouse and the cars switched to the sorting platforms. Here it is sorted, classified and eventually reloaded when sold. This system requires three handlings, as against one if the classification is made at the point of origin. It also requires the provision of

sorting platforms, loading and unloading equipment and track facilities to serve them. In addition, the cars are held under load for a longer total period and in many instances there are unprofitable non-revenue back hauls.

### Scrap Bins Aid in Making Classification

By V. H. SHORE
Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

It is assumed that the question refers primarily to miscellaneous scrap, but since considerable scrap rail always accumulates in yards, I will include this in my discussion. In my opinion, the foreman should personally oversee the loading operation and thus make sure that no serviceable material gets into the scrap car. In a busy yard, or even on outlying sections, it is almost impossible to keep the scrap and the usable material from getting mixed while they are being picked up. It is a good plan, therefore, to provide scrap bins so that the usable material can be separated from the scrap at the time it is brought in. This will save considerable time in sorting and will also reduce the time required for loading.

In terminal or large intermediate yards, the usable car and locomotive material can usually be turned over to the mechanical department currently, thus saving a second handling or the accumulation of usable material of this character. Whenever this is not practicable, disposition should be obtained at frequent intervals in order to keep the good material moving.

Scrap rail should be segregated from other forms of scrap and also kept separate from usable rail. It should be marked distinctly and piled so that it can be inspected easily by the division officers, since the best of this rail can frequently be used in unimportant sidings, thus making an equal amount of good rail available for more important tracks.

Rails of considerable length, but having bad ends are not necessarily scrap, if the remainder of the rail is good. Such rail can be used in sidings by cutting the ends back and drilling. Many other defective rails which are not suitable for main track or intensively used leads can also be used in yards and sidings, since their intrinsic value is much greater than that of scrap. Some of the defects that render rails unfit for any use are badly corroded bases, badly worn heads, split or mashed heads, cracked webs, line and surface bends that cannot be straightened easily, short lengths and sections too light for the equipment they must carry.

### Should Classify Track Scrap Only

By J. A. SPURLOCK
Roadmaster, Missouri-Kansas-Texas, New Franklin, Mo.

Section forces should be required to sort and classify all track scrap before shipment, and the roadmaster should make an inspection of the scrap before it is loaded. A good plan is to have the section forces assemble and sort it at the tool house or some other convenient place for loading. The roadmaster should then make an inspection with the section foreman to insure: (1) That there is no usable material in the scrap stock; and (2) that the proper classifications have been made.

If usable material is found, it should be used in preference to ordering new material or, if not needed on the section upon which it originates, it should be shipped to some other section. If there is no immediate use for it on the roadmaster's district, it should be segregated and shipped to the stores department and credit taken. If it is not segregated or if proper notice is not given the stores department, the second hand material may be sold as scrap, or at best the division will receive only scrap credit for it.

If for any reason the classification cannot be made at section headquarters, the scrap cars should go to the roadmaster's headquarters where all serviceable material should be removed before the cars are forwarded to the reclamation plant. Section forces should be trained to sort all scrap, but the roadmaster should be held responsible for the manner and completeness with which this operation is conducted.

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## Testing Foundation Piles

*What satisfactory method can be employed to test the bearing power of foundation piles* ?

### Commonly Uses Penetration Data

By G. A. HAGGANDER
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

The most commonly used method on this road is to note the penetration of the piling during the last few blows, after which the Engineering News formula is applied. Most of the bridge foundations on the Burlington have been driven and redriven and we have kept records of the penetrations obtained and the performance of the piles. By using these data we are able to select piling of proper length with accuracy. In some instances we strike a soft spot, usually an old river bed, where we get considerable penetration during the last blows, but still have a satisfactory total depth of penetration. Experience has shown that in most cases, however, these piling will bear the load satisfactorily.

In special cases, we have made tests of the supporting power of the piles by actually loading them. This is a rather expensive procedure so that we do not resort to it frequently. In one case where we applied this test, we were able to load a timber pile up to 80 tons, this pile having a good penetration in sand and hard clay. Concrete piling which were on the ground were used for the load. In view of the expense involved in this kind of a test, however, we usually confine ourselves to the driving of test piling and observe the penetration under the last few blows, at points where we do not already have the required information.

### Loading Test Gives Most Reliable Data

By Superintendent of Bridges

We make no loading or driving tests for many of the foundation piles which we use. Familiarity with many of the soils we encounter, the light loading that is often employed and the records which we have kept over a number of years makes either type of test unnecessary for a large percentage of our structures. Where a foundation of any importance is under consideration we always require borings to determine the character of the soils that will be encountered. If there is any question as to their probable performance we make both soil-bearing and pile-bearing tests.

In some instances the penetration test is deemed sufficient, in which the bearing power of the pile is calculated from its penetration under the last few blows of the hammer. Where the loading is heavier or the structure is of greater importance, it is our custom to require

a loading test, since we consider that this provides the most reliable data on the performance that can be expected from the piles in the structure. This is accomplished by driving four piles, placed at the corners of an 8-ft. square, on the site of the foundation or adjacent to it, if the borings show the same conditions. Sills, 12-in. by 12-in. or 12-in. by 14-in. are drifted to each pair of plies about 18 in. to 2 ft. above the ground. In general, slightly-worn second-hand rails are used for the load, and great care is used to distribute the load equally on all of the piles. After half of the proposed permanent loading has been applied, an interval of 24 hours is allowed to elapse and readings are taken to determine the amount of settlement, if any, at each pile. This is repeated for ¾ loading and then for full loading, after which 48 hrs. elapse before a reading is taken. If this proves satisfactory the load is increased by increments in the same manner to practical destruction of the bearing power of the piles.

In a few instances pig iron has been used for loading, but this has the disadvantage that the weights of the several increments of loading cannot be calculated as closely as with rails. Furthermore, it is not as simple a matter to handle and pile it on the test platform which must be laid on the sills, while the car containing the remainder of the pig iron must be weighed after each increment has been applied.

## Shimming Track

*What methods should be followed in shimming track to minimize the spike cutting of the ties? What differences in methods are necessary where tie plates are used* ?

### Preboring Ties Is Good Practice

By G. STAFFORD

Section Foreman, Canadian National, Rosebud, Alta.

As a result of the installation of adequate surface and subsoil drainage in recent years, the heaving of track has been practically eliminated in many places and greatly reduced in others. To a certain extent, however, it is probable that shimming will always be necessary in some places. Where shimming is necessary the ties are always subject to considerable damage through constant respiking, with the corollary of earlier decay as a result of the freer entrance of moisture.

While a certain amount of damage cannot be avoided, care on the part of the section forces will often result in a material reduction of this damage. It is good practice to prebore all ties that are to be used in heaving territory, using four holes at each rail, the extra holes in untreated ties being protected by hot creosote or by a hot mastic filling. Ties already in service can be bored with a ship auger or other boring tool. This permits the spiking to be reversed without serious damage to the tie. When it is necessary to apply braces, holes should also be bored to accommodate the brace spikes. When removing the braces or shims, or in respiking, the holes should always be plugged with a machine-made tie plug. Special attention should be given to driving the spike vertically, square with and snug against the rail. The spike hole in the shim should be carefully lined with the hole in the tie.

Heaving track generally recurs year after year at the same place until adequate drainage is provided. Furthermore, the intensity of the heaving does not increase noticeably after the ground is frozen to a depth of several feet. For this reason, if the last few adjustments are made with shims less than ½ in. in thickness, they can be removed as the frost leaves the round, by easing the spikes slightly, thus avoiding considerable respiking. Removal of the thin shims can be simplified if they are notched for the spikes, instead of being bored. The methods which have been described are equally applicable for track that is fully tie plated.

### Would Remove Tie Plates

By Assistant Engineer of Maintenance

Practically no difference in methods of shimming is called for as between track that is tie-plated and track that is not. If the track is tie plated and the thickness of the shims is ½ in. or less, the shim can be placed under the tie plate and held in place by nailing it to the tie. Many tie plates have slightly deformed bottom surfaces designed to give a grip on the tie. In some instances the deformations are sufficient to hold the shim in place, eliminating the necessity of fastening it by any other means. If it becomes necessary to use shims thicker than ½ in., the tie plates should be removed.

Conservation of ties is of such importance that every possible means should be employed to minimize damage from every cause. In this case the original spike holes should be plugged and used in respiking after the shim is applied. When it is necessary to use rail braces in connection with the shimming, the braces should be applied to the same tie year after year and the old spike holes used so far as this is practicable.

## Driving Concrete Piles

*What are the relative advantages and disadvantages of steam and drop hammers for driving concrete piles* ?

### Prefers the Steam Hammer

By Assistant Engineer of Bridges

Concrete piles are larger and much heavier than comparable wooden piles, so that they require heavier driving equipment to overcome the inertia of the greater mass. While drop hammers can be used in many cases to drive concrete piles, the practice has little to commend it. The interval between blows is so great that the pile must be started from a state of rest at each blow. For this reason, a large part of the energy delivered by the pile hammer is absorbed in overcoming the inertia of the pile and starting it, so that a relatively small amount of the energy developed by the falling hammer is available for moving the pile after it is started. Furthermore, during the interval between blows, the soil surrounding the pile is given an opportunity to consolidate and grip the pile. It is the common experience that the skin friction at starting is greater than that developed during the movement of the pile, and this adds to the initial resistance against starting which is due to inertia.

On the other hand, a steam hammer of proper design and weight will deliver harder blows with less shock to the pile, with a rapidity that does not allow the pile to come to rest or the ground to consolidate in the interval between blows. Thus both the inertia against movement and the resistance set up by skin friction are reduced to

a minimum and the danger of damage to the pile from the shock of the blows is largely eliminated.

From the standpoint of economy the steam hammer has a distinct advantage over the drop hammer when any number of concrete piles are to be driven, in the greater speed of driving, the reduced damage to the piles, the better control of driving that is possible and the smaller amount of labor that is involved.

### Steam Hammer Is Best

**By C. S. HERITAGE**

Bridge Engineer, Kansas City Southern, Kansas City, Mo.

Concrete piles can be driven with either type of pile hammer. When using a drop hammer, however, it is best to use a heavy hammer with a low drop, since a light hammer which requires a long drop in order to move the pile will be more likely to damage it. For ordinary conditions of driving, a steam hammer will give better results with concrete piles than can be obtained with a drop hammer.

Steam hammers drive concrete piles with less hazard of injury to the pile as a result of excessively heavy blows, and will force a pile through sand where a drop hammer will fail. If a steam hammer is used, piles can be driven a considerable distance below the leads without a follower or the use of extension leads, which is a distinct advantage in railway work.

Concrete piles are larger and heavier than wooden piles and for this reason better results are obtained by using a hammer heavier than is customary with wooden piles. This holds true for both drop and steam hammers. The leading contractors who handle pile driving use steam hammers almost exclusively, this practice being based on their experience with both types of hammers. We have used a drop hammer with success in driving concrete piles when assisted by a jet, but for straight driving we prefer a steam hammer.

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## Foreman's Track Inspection

*What benefits, if any, are derived from requiring the section foreman to walk over his section? How often should he do this* ?

### Is Able To Plan His Work Better

**By W. H. SPARKS**

Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Every section foreman whose heart is in his work will walk his track periodically, whether or not this is required by his superior officers. Any experienced foreman knows the value of this practice and the benefits he derives, if only in the planning of his work for the week or month in advance. As an alternative, particularly during the busiest season, some of these trips can be made on a velocipede car with a marked saving in time. The trips should be made at slow speed, however, or many items of importance may be overlooked.

The primary purpose of such an inspection is to assure that the foreman will at all times have a detailed knowledge of the condition of his track, switches, road crossings, railway crossings, fences, right of way, drainage, bridges, culverts, and other items for which he is responsible. He will know at first hand what defects are developing and what things should be given preferred attention. He is also able to check how thoroughly his track walker is making his inspections. Another important feature is the opportunity that is afforded to meet and discuss matters of mutual interest with farmers and other persons whose property adjoins the right of way.

The frequency with which the foreman should make these inspections depends upon the density of traffic, the alinement and grades on the section, the character of the rails, ballast, ties, drainage, etc. In my opinion, the average interval should be not greater than a week, although conditions on some sections may demand two trips a week.

### Foreman's Inspection Is Important

**By S. A. MEARS**

Section Foreman, Missouri-Kansas-Texas, San Antonio, Tex.

Usually it is only by close and detailed inspection that incipient defects can be detected. Some of these defects may be of minor importance from a safety standpoint, while others may quickly develop into conditions of major importance. No matter how well qualified the regular trackwalker may be, he does not bear the same responsibility in the matter of finding and correcting defective conditions as the foreman. Neither should the foreman be relieved of or delegate any of his responsibilities.

For these reasons, I consider it important that the foreman walk over his track at intervals, observing closely every detail of the track and roadbed structure, the right of way, the fences, the road crossings, drainage and other items for which he is responsible. He should pay especial attention to the condition of the rail, particularly with respect to flaws, to joint fastenings, bolts, spikes, tie plates and anti-creepers and to the line, surface and gage. He should determine the cause of any irregularities he may find and the best method of correcting them. One of the most valuable features of this inspection, however, is that the foreman has currently a detailed knowledge of the conditions on his section and what is needed to keep it up to the standard of maintenance in effect on his road.

Although an experienced man can make a reasonably good inspection from a slowly moving car, so far as obvious defects and general conditions are concerned, the smaller defects which often need immediate attention are likely to be unnoticed. If seen, it may need a closer study than is possible from a moving car, to realize their importance.

The frequency with which inspections should be made depends on the physical conditions of the section. With new, or nearly new, heavy-section rail, good ballast and ties, with first class drainage, once a month may be often enough. With lighter rail that has seen several years service and which is not so well maintained, once a week is not too often.

### Approves Present Trackwalking System

**By N. F. ALBERTS**

General Foreman, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The practice of having assigned trackwalkers is a good one, since it relieves the foreman of considerable detail and permits him to spend the greater part of his time with his gang, as he should. A trackwalker should be an experienced trackman, who is able to make minor repairs of any character and, if need be, to supervise several men who may be required to assist him at times. The proper inspection of high speed main tracks and complicated track layouts in large yards is a matter of

prime importance, and should not be left entirely to subordinates.

Since the responsibility for safe and proper maintenance rests upon the foreman, it is important that he have a first hand knowledge of all of the conditions on his section. For this reason, he should make a personal inspection at short intervals, say once a week, choosing his time so that there will be the least interruption to his work schedule. The most favorable time for doing this is usually the latter part of the week.

The benefits derived from this practice may be stated briefly by saying that he will ordinarily observe certain details that may have been overlooked by the trackwalker. It also gives him a frequent check on work that should be given early attention and enables him to work out a consistent schedule that will cause a minimum of interference with his main program.

## Detailed Inspection Is Always Needed

By G. W. EVANS
Section Foreman, Missouri-Kansas-Texas, Elgin, Tex.

From personal experience I am of the opinion that a foreman cannot handle his section efficiently unless he is familiar with all of the details relating to the condition of his track structure, roadbed and right of way. The only way by which he can gain this familiarity is to make regular inspections at such intervals as will keep him informed currently of these conditions. By walking over the section he will be able to observe many things that are sure to escape notice if the inspection is made from a motor car.

When walking, he has ample time to stop and examine cracked joint fastenings, loose bolts, evidence of piped or split-head rails and other rail defects. He will notice loose ties at bridge ends, incipient spreading, defective ties, weak places in the embankment, ditches that need cleaning or reforming, and the condition of fences, gates and road crossings.

There should be no specified time, since such an arrangement may interfere seriously with his work. But he should make the inspection often enough to retain a mental picture of every condition that needs attention. He is thus able to plan his work to the best advantage with respect to time and cost, and with due regard to the disarrangement of his main program.

## Once a Month Is Sufficient Ordinarily

By J. A. SPURLOCK
Roadmaster, Missouri-Kansas-Texas, New Franklin, Mo.

If the track is laid with heavy rail, is well tied and well ballasted, and the traffic moderate in volume, once every 30 days should be often enough for a section foreman to walk his track, except that, if the alinement includes sharp curvature, the inspection should be made weekly. If the rail and fastenings are worn, the ballast foul and the tie condition subnormal, the interval between inspections should not exceed one week, particularly in the winter or during wet weather.

These inspections by the foreman are essential to insure safety. When making his inspection on foot, a foreman has a much better opportunity to ascertain conditions in detail with respect to gage, defective joint fastenings, bolts and rails, as well as many other items which require close inspection.

Unless the foreman walks his track from time to time, he is likely to overlook some condition that might cause an accident, and that can be detected only by close and careful inspection. Many times cracked joint fastenings, spreading track, light cross swings, piped or even broken rails are not observed when running on a motor car at a speed of 15 to 25 miles an hour. For these reasons foremen should be required to walk their track as frequently as the physical conditions indicate that it is necessary to do this.

## Practice Should Always Be Followed

By J. J. HESS
General Roadmaster, Great Northern, Seattle, Wash.

Experience has shown that it is an excellent practice for section foremen to walk over their track periodically. Many details can be observed when on foot that escape notice from a motor car or velocipede. These include particularly bolts that are slightly loose, defective rails and joint fastenings, broken tie plates, broken, bent or missing spikes, broken or missing bolts, etc.

When walking, a foreman is able to concentrate his attention on what he is observing and can stop and make a close inspection of any defect he sees. If he is passing on a motor car his mind is occupied with a number of things, including the operation of the car and the possibility of accident at road crossings or with trains. He is unable, therefore, to concentrate his attention on any one thing. No matter how slowly the car is traveling, many small details must of necessity pass unobserved or, if seen, their importance may not be understood. In my opinion, a foreman should make an inspection of the character indicated in the question at least once every 60 days in the summer and fall and once a month in the winter and spring.

## Several Benefits Are Derived

By V. H. SHORE
Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

There are several good reasons why a section or yard foreman should walk his track periodically. He is, or should be, expert in detecting irregularities and small defects that should be taken care of to prevent then from developing into dangerous conditions. This prac tice has a tendency to cause the regular trackwalker tc be more alert, since he is aware that his foreman will check his inspection within a few days.

Again the foreman who makes such inspections knows at first hand that his section is in safe condition. He is able also to plan his work to better advantage because he knows his section in greater detail. In my opinion, where conditions permit this to be done, a foreman should see his entire section at least once a week, but should have no regular day for doing so, in order that the trackwalker will not know when he is to be checked up.

## Keeps Him in Touch with Conditions

By R. D. COPELAND
Engineer Maintenance of Way, Ann Arbor, Owosso, Mich.

Every section foreman should be required to walk over his entire section periodically, at intervals not greater than two weeks, and oftener if conditions make this practicable. In doing this the foreman himself is benefitted by the fact that he is kept in close personal touch with all of the conditions on his section and is thus enabled to repair or watch minor defects and thereby insure that they do not develop into unsafe conditions. His standard of maintenance is improved because he has personal knowledge of the condition of every detail of the track structure, the roadbed, the drainage, the

road crossings, fences, etc. He is able to take sufficient time to examine rails, joints, bolts, spikes, ties and other items for defects which can not be observed except through close and careful inspection.

The section over which he has jurisdiction is benefited by the fact that, with the knowledge thus acquired, he is able to plan his work better and to give attention to small defects as they occur, rather than after they have become obvious or have developed into unsafe conditions upon which more time and labor must be expended.

## Inspecting Sewers

*What methods can be employed to protect against sewer gas when inspecting sewers* ?

### Should Always Suspect Sewer Gas

By Sanitary Inspector

While sewer gas is not always present in dangerous quantities, its presence should always be suspected and proper precautions taken to guard against explosions, which will occur if it becomes ignited, or the danger of men being overcome by inhaling this gas. The ordinary precautions to follow in guarding against the effect of these gases are:

1. The presence of sewer gas can often be detected by its odor. For this reason, if such odor is apparent men should not be permitted to enter the sewer or go down into a manhole.

2. If there is any indication of gas, manhole and catch basin covers should be removed and the sewer ventilated as thoroughly as possible.

3. If there is no apparent odor, the manhole covers over a section of the sewer should be removed and a burning newspaper or piece of waste should be tossed into one or more of the manholes. Every one should stand clear of the manhole to avoid injury, in the event that the gas ignites or explodes. Sewer gas explosions will not cause damage if the manhole covers are removed.

4. After these precautions have been taken, the man who enters the sewer should have a rope attached to his person, by which he can be pulled back, if gas remains in sufficient quantities to overcome him.

### Precautions To Be Taken Are Simple

By Inspector of Water Service

In discussing this subject it should be kept in mind that sewer gas never collects in quantity in a clean or well ventilated sewer. If the ventilation is inadequate or sufficient organic sediment is allowed to collect on the bottom of the sewer, sewer gas, which is identical with marsh gas or fire damp, may collect in sufficient quantities to be dangerous in two ways, through ignition or by causing asphyxiation.

It should also be borne in mind that sewer gas in itself is entirely odorless and can be detected in only one way —by its highly explosive character when mixed with air. The odor which is so frequently detected in sewers is almost always that of illuminating gas or oils which find their way into the drain, or originates from other substances, such as industrial wastes, which are present but do not generate gases.

Before entering a sewer, the covers should be removed from the manholes and catch basins over the section to be inspected, and a lighted newspaper or torch should be tossed into each of these openings. The man doing this should stand far enough away from the opening to insure that he will not be burned if the gas should ignite or explode. When he enters the sewer, he should be provided with a harness to which is attached a rope which can be used to pull him out in case sufficient gas is left to overcome him.

## Laying Cast Iron Pipe

*When laying cast iron pipe, what precautions should be observed to minimize the danger of later service breaks in the pipe and to insure that the line will function properly in service* ?

### Should Begin with the Design of the Line

By J. H. DAVIDSON

Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

The precautions that should be taken in the construction of cast iron pipe lines to minimize the danger of later service breaks, should begin with the design and location of the lines. A careful study of the conditions under which the line will be required to function should first be made to determine the class of pipe and type of joint which are best adapted for the service. The probable necessity and locations for providing blow-off valves, pressure regulators and relief valves, and of provisions for expansion and contraction should also be determined at this time.

In general, the plan should provide for laying the pipe in as straight a line and on as continuous a grade as construction costs will warrant. All unnecessary bends and fittings should be eliminated. Where bends are required, those of 22½ deg. and 45 deg. should be used in preference to bends of 90 deg. If bell and spigot pipe and lead or similar joints are used, slight deviations from the general alinement can be made without the use of fittings, by deflecting several lengths of pipe slightly at the joints before the joints are completed. No deflection should be attempted after this type of joint is finished, however. There are other types of joints on the market which provide for a certain degree of flexibility in this respect.

The trench in which the pipe is to be layed should be deep enough to eliminate danger of freezing and to provide sufficient cover to avoid other forms of outside damage. If the trench passes through rock, it is advisable to place a layer of fine material in the bottom of sufficient depth to bed the pipe properly. The pipe should be clean inside and out before being lowered into the trench, and care should be used during the assembly to insure the exclusion of all foreign substances from the interior.

Lines passing under tracks or which are placed in other locations subject to great vibration should be constructed with special joints which are not seriously affected by vibration. Better yet, they should be placed in suitable conduits for protection against vibration, which should be of sufficient size to allow access for making repairs.

In assembling bell and spigot pipe, the spigot end should always be forced firmly against the shoulder of the bell and centered so as to provide adequate and uniform space at all points for finishing the joint. If irregularities occur which prevent a good joint, the section of pipe should be discarded. Other types of joints should be assembled according to the maker's instructions.

The pipe should be bedded uniformly and not be allowed to rest on rocks or other unyielding substances. It is advisable to use blocking or wedges under special fittings and valves and to block sharp curves against the side of the trench, to prevent shifting due to either internal pressure or expansion.

The backfill should be placed and tamped carefully under and around the pipe and then on top of it, using special care where blocking or wedges have been installed. Large stones should never be allowed in the backfill close to the pipe.

For lead joints, the pipe should be centered and the packing carefully inserted and packed with a proper yarning iron. The joint should be dry and clean and filled with lead at one pouring.

If possible, the completed line should be tested, preferably by sections, before the trench is backfilled. The hydrostatic pressure that is applied should be considerably higher than the working pressure to which the line will be subjected. Leaking joints should be recalked and any defective material replaced.

Careful and constant inspection to insure against poor workmanship and defective material will invariably prove less expensive than repairs after the line is in service, to say nothing of potential losses from hidden leaks.

## Care Insures Against Service Defects

**By Inspector of Water Service**

If properly laid, cast iron pipe should not be afflicted with service breaks to any greater extent than pipe of any other kind. In attempting to discuss the precautions that should be observed during installation to minimize later breaks in service, it is desirable to consider the causes of such breaks. The principal causes are:

1. Cracked pipe or defective castings which were not discovered during inspection or during installation.
2. Unequal bearing of the pipe in the trench as a result of the pipe resting on some unyielding object.
3. Excessive external load from backfilling, shifting of the pipe as a result of settlement or movement of the ground.
4. Passing the pipe through or under foundations of buildings or other structures.
5. Passing the pipe under tracks.

Cast iron pipe should be inspected carefully before it is laid. The mill inspection should be followed by an equally careful field inspection to guard against such defects as result from damage during transportation or handling. Sounding the pipe with a hammer will usually determine the pressure of cracks.

The bottom of the trench should be prepared with a view to providing as nearly a uniform support for the pipe as practicable. Under no circumstances should the pipe rest at any point on a large stone, a rock ledge or other unyielding object.

If there is any probability that the pipe will shift under the load of the backfill, the backfilling material should be tamped carefully under, around and over the pipe. Pipe should never be laid in or under unsettled embankments, if this can be avoided. If it becomes necessary for any reason to lay the pipe in a green fill, it should be well supported throughout its entire length on piles or other suitable support. In swampy ground or other soil of similar instability, the pipe should be supported in like manner, or blocked, to avoid movement and possible breakage. In extremely soft, marshy ground, it sometimes becomes necessary to provide a trestle to support the pipe line.

The construction of pipe lines through or under foundations is not desirable, although it cannot be avoided at times. In the event that this must be done, an opening should be provided in the foundation, larger than the pipe, to allow a slight movement of either the pipe or the foundation to take place without seriously affecting the other. This opening can be calked with yarn to make it waterproof.

Unprotected pipe lines under tracks are often subject to breakage as a result of the shock and vibration of passing trains. To prevent breakage from this cause, the tracks over the pipe should be supported to relieve the pipe of the weight of the moving trains or, a more desirable and often more practicable solution, the pipe line should be installed inside a larger concrete or cast iron pipe. In extreme cases, where the pipe line is laid in unstable, marshy ground, it has become necessary to construct a standard ballast-deck trestle to support the tracks in order to protect the pipe.

## Care in Calking is Essential

**By J. A. CRAWFORD**

Bridge and Building Master, Canadian National, Kamloops, B. C.

It happens sometimes that pipe is damaged while enroute to the point where it is to be installed. Frequently it will be found that the constant movement of the bell end against the side of another pipe has caused that section to be worn entirely through. During unloading, particular care should be exercised to detect sections that have been damaged in this manner. In addition, while the pipe is being unloaded, care should be taken to avoid damaging it by rough handling or by any other means.

All contract work should be watched closely by a competent inspector who has had practical experience in the installation of pipe lines. Ditches should be dug as straight and level as possible and the barrell of the pipe should rest evenly on the bottom of the ditch. If the material is wet and soft, the bearing surface can be improved somewhat by ramming gravel into the bottom of the ditch before the pipe is laid.

The bell ends should always be laid in the direction that the work is progressing so that the calking will be done against the main line of pipe. It is necessary that the pipe be rammed firmly against the previous section before the calking yarn is placed. The joints should be calked sufficiently tight to preclude the possibility of any lead getting past the yarn into the pipe. I have observed slabs of lead inside pipe as large as a man's hand, which were caused by careless workmanship in calking the joints.

All stones in the ditch should be taken out or broken down so that they will be clear of the pipe. The first foot of cover should be placed by hand, care being taken not to allow boulders to bear against the pipe. Inexperienced men should never be allowed to participate in the laying and calking of pipe.

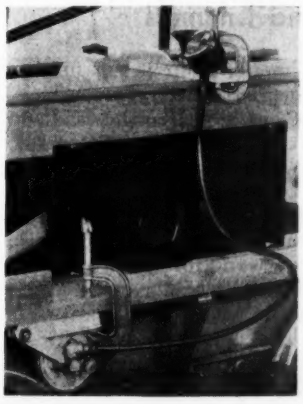
The weight of pipe is generally marked on each section, and if a piece is found to be lighter than the average it should be culled, as it is likely to contain hidden air holes or slag. Before the pipe is lowered into the ditch each piece should be sounded with a hammer in order to detect possible cracks.

In all cases a check valve should be placed in the pipe line near the pump. If a plunger pump is used to pump against a high head, a waste line should be placed between the pump and the check valve so that all air will be discharged and the pump primed fully before the valve in the waste line is closed slowly.

# NEW AND IMPROVED DEVICES

## Fairmont Develops Motor-Car Speedometer

FAIRMONT Railway Motors, Fairmont, Minn., has recently placed on the market a motor-car speedometer which may be clamped readily to any motor car. The device is designed to be used as a check on motor car mileage, speed and fuel consumption. It also may be used in the testing of new or overhauled motor cars and as a means of ascertaining the speed attained in a given time or distance, indicating the relative condition and efficiency of cars of the same model. The speedometer is actuated by a small disc which contacts with the perimeter of the motor-car wheel. It is claimed that this device registers accurately the speed and mileage of a motor car, regardless of the size of the wheels or the direction in which the car is moving.



One of the New Speedometers attached to a Motor Car.

## Metal Highway Crossing Has Special Features

A NEW type of all-metal highway crossing, known as the Smithsteel Highway-Rail Crossing, has recently been placed on the market by the A..O. Smith Corporation, Milwaukee, Wis. The crossing is constructed principally of specially-designed steel channels that are laid parallel to the rails and anchored securely to steel box-section fillers which are supported on and fastened to the ties.

The channels are 3$\frac{9}{32}$-in. deep and 3$\frac{1}{4}$-in. wide, and are furnished in 6-ft., 7$\frac{1}{2}$-ft., 9-ft., and 10$\frac{1}{2}$-ft. lengths, in order that the end joints of the channels in the crossing will be staggered. At 3-in. intervals in the top of each channel, two $\frac{1}{2}$-in. round holes, one near each edge of the channel, have been provided, the circumferences of which are raised slightly to present a non-skid surface. These holes also serve the purpose of allowing for expansion during the formation of ice, in the event that the crossing is submerged during freezing weather.

The top of each channel has a slight upward bulge and contains a series of shallow grooves or corrugations at right angles to the center line of the channel and about 3 in. apart. These grooves are about $\frac{1}{4}$ in. deep and $\frac{3}{4}$ in. wide, and are located midway between the pairs of $\frac{1}{2}$-in. holes. Their purpose is to strengthen the channels and to add to the non-skid properties of the crossing.

The lower $\frac{3}{4}$ in. of the legs of each channel are bent inward at right angles to form a bearing against the support and also to afford a means of anchoring the channel. The box-section fillers to which the channels are anchored are 4 in. high and 5$\frac{1}{2}$ in. wide. A filler is fastened to each tie at right angles to the center line of the track with $\frac{3}{8}$-in. by 9-in. boat spikes. At proper intervals in the top surface of these fillers two small rectangular sections are cut loose on three sides and bent upward in such a manner that a fastening for the legs of the channel is formed.

The method of installing the channels is to lay the locking plate fillers first and then to slide the channels in place. Notches are provided in the bottom flanges of the channels and are spaced the same as the lugs on the locking plates, so that only a 9-in. longitudinal movement is required to lock the channels securely in place.

A View of an Installation of the Smithsteel Highway Rail Crossing.

Thirteen lines of channels are required between the rails in standard-gage track. The crossings are insulated electrically by two longitudinal $\frac{7}{8}$-in. thick, insulating strips between the fifth and sixth channels from each rail. The insulation extends down to the top of the ties, thus requiring that the metal fillers between the rails be divided into three lengths.

The flangeways are formed by a specially-shaped channel that is anchored in the same manner as the standard channels, while the space between the rail and the outside channels is filled by an inverted simple channel, one leg of which is welded to the adjacent crossing channel.

The ends of the crossing are protected by sheet-metal ramps that are spiked to the ties and also secured at the top edges, which are curved downward and fastened to the first locking-plate filler.

## Pipe Has Spiralwelded Lock Seam

GREATER strength, light weight and a continuous expansion joint are among the advantages claimed for a new design of metal pipe, based on a continuous spiralwelded lock seam. This pipe, which is known as Naylor Spiralweld Toncan iron pipe, was developed and

Cross Sections of the Spiralweld Lock Seam Before and After Welding

is being manufactured by the Naylor Pipe Company, Chicago.

The pipe consists of Toncan iron strip wound spirally on a turned mandrel and secured at the seams by means of a lock-seam joint, the joint being sealed by welding.

Lowering a Section of Naylor Spiralweld Toncan Iron Pipe.

As is readily seen from the illustration shown the cross sections of the seam, the seam design is such that the circumference of the pipe may increase or decrease a slight amount under stress, thus imparting to the pipe a flexibility which provides for expansion and contraction and resistance to shock, fluid load and vibration. Owing to the manner in which it is wound, the pipe is said to be perfectly round at all points.

During actual tests made with this pipe, it was demonstrated that the spiralweld lock-seam increases considerably the resistance of the pipe to internal hydrostatic pressure and that the bursting strength is much greater than the computed strength of a plain pipe of the same thickness of wall. The effectiveness of the spiralweld in stiffening the pipe against external hydrostatic pressure and crushing stresses has been made apparent in the same manner.

This pipe is manufactured in diameters ranging from 6 in. to 20 in., weighing 9.5 lb. and 35 lb. per ft. respectively. It is furnished in 20-ft., 30-ft., and 40-ft. lengths and the ends may be grooved for Victaulic couplings, left plain for the Dresser type bolted joint coupling, or beveled for butt welding.

## Du Pont Company Develops New Finishes and Enamels

AN entirely new line of interior and exterior finishes and enamels, employing an entirely new vehicle, has been developed and put on the market by E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. The new vehicle, which is called Dulux, has been developed in two forms; a gum, which is used as the vehicle in the enamels, and an oil, which is used as the vehicle in the new exterior and interior finishes, designed for use in the same class of work for which ordinary paints are now used. Both forms of the new vehicle are distinct chemical compounds, made by chemical reactions requiring extremely close chemical control, and have no relation to the usual resins, gums and oils used in ordinary paints.

Dulux gum, which is used as the vehicle in Dulux enamels is a rubbery material, which hardens to the toughness of horn, while Dulux oil, which is used as the vehicle in Dulux interior and exterior finishes, where a softer but more durable film is desired, is a synthetic oil derived from Dulux gum. Based upon the characteristics of the Dulux vehicles, many claims are made for the Dulux finishes and enamels developed, all of which, it is pointed out, are the result of extensive exposure tests wherein direct comparison was made between Dulux products and other paints, varnishes and enamels.

With regard to Dulux interior and exterior finishes, which are designed for application over either wood or metal surfaces, it is claimed that Dulux stands up longer and possesses greater resistance to checking and cracking. It is also claimed that Dulux in tints and solid colors retains its gloss and color longer, this being due to the fact that Dulux is slow in starting to chalk, and that the chalking proceeds at a much slower and more uniform rate. It is claimed further that Dulux protects metal against the corrosive action of gases, fumes, salt-laden atmosphere and moisture to a greater degree, owing to the highly impervious character of the film which it produces and the resistance of this film to the growth of mold and fungus.

Other claims made for Dulux exterior and interior finishes are that they possess good hiding and spreading

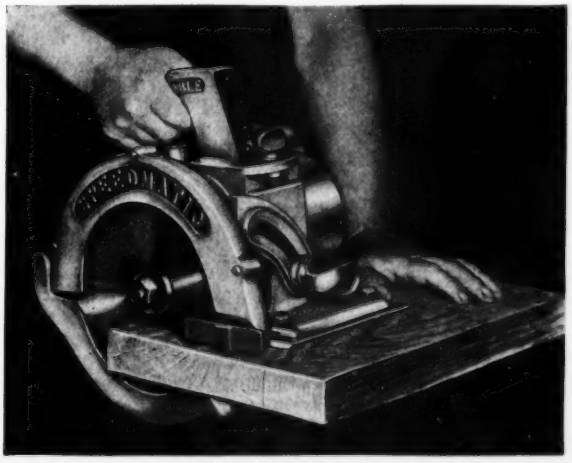
qualities; that they are highly resistant to spotting and smudging; and that they retain their original appearance much longer. These new finishing materials, which are adapted for application to buildings, bridges, tanks and other wood and steel structures, are readily atomized and, therefore, may be applied by the spray as well as the brush method. Under ordinary conditions, Dulux interior and exterior finishes are dust-free in 3 to 6 hours, and are dry enough for recoating in from 8 to 18 hours.

Dulux enamels, which are based upon the Dulux gum vehicle, or upon mixtures of this vehicle with Dulux oil, are intended for places where the quality of durability must be combined with faster drying and harder surfaces, and where finishes of enamel-like appearance are needed or desired.

In addition to having the favorable qualities of Dulux interior and exterior finishes, it is claimed from the comparative tests made, that Dulux enamels, which may also be applied by either the spray or brush method, provide an exceptionally hard film, which is highly resistant to marring, heat, alcohol, gasoline and oil, and which retains its flexibility over long periods, preventing chipping or cracking. These enamels dry quickly, being dust-free in approximately 20 min., and may be recoated within one hour after the first application. The enamel film is thoroughly hardened in 10 to 12 hours.

## New High-Speed Hand Saw

THE Porter-Cable-Hutchinson Corporation, Syracuse, N. Y., has placed on the market a new portable electric power hand saw known as the Speedmatic saw, Type K-9, which is designed to give unusually high-speed operation. The blade of the saw, which is 9 in. in diameter and fully guarded throughout its periphery, is driven by a 1¼-hp. motor, geared to the drive arbor through hardened spiral gears having a reduction ratio of 2¼ to 1. This motor drives the blade at an unusually high speed for this type of saw, the blade running at 5,000 r.p.m. when not under load, and about 4,000 r.p.m. under the average cutting load. With this high-speed operation, it is said that it is possible to rip a 3-in. plank, 12 ft. long in one minute; to cross cut a 3-in. by 6-in. piece in two seconds; and to cross cut a 2-in. by 12-in. piece in four seconds. The maximum depth of cutting with this saw is 3⅛ in.



The Speedmatic Power Saw.

# What Our Readers Think

## Butt Welding Rails

St. Louis, Mo.

TO THE EDITOR:

In his article on page 552 of the December, 1930, issue of *Railway Engineering and Maintenance*, with the title "Lengthening Rails by Butt Welding," L. C. Ryan makes several statements that are quite at variance with experience in American railroading.

The butt welding of rails in tunnels and through road crossings and station platforms has proved quite satisfactory, since in such locations the rails are protected from wide temperature changes. In fact, the butt welding of rails in street car tracks where the tracks are laid in paved streets has been practiced for many years.

However, the statement that "German engineers . . . have found that all of the expansion and contraction resulting from temperature changes is confined to approximately 40 ft. at the ends of any length of rail" does not seem to be applicable to conditions in this country. In Germany, the two rails, the fastenings and the ties are all held together as one unit. With this type of construction, providing as it does, in properly ballasted track, adequate anchorage as well as resistance to buckling, it is conceivable that the forces tending to resist movement by expansion or contraction would be sufficient to actually prevent such movement, and the general truth of the statement that only the 40 ft. at the ends of any length of rail is affected might be admitted. In the type of construction commonly used in this country, however, the ties and fastenings serve only to limit and not to prevent movement of the rail, thereby setting up quite a different situation. In this type of construction, also, the tendency toward creeping is at best but partially controlled, and this force is added to the force of expansion or contraction with results that are well known to railroad men who have had experience with "sun kinks." In the absence of the rigid type of construction that is used in Germany, the extension of the practice of butt welding to rails in open track will, in my judgment, invite trouble.

The statement, also, that "the butt welded rail joint will eliminate rail creeping" is, I believe, only a partial truth. As a remedy for rail creeping, butt welding would be effective only where coupled with a type of construction in which the rail is rigidly attached to the tie to prevent buckling; and with such construction each tie would serve as an anchor. In the end it would appear to be the anchoring ties that prevent the creeping rather than the butt welding.

G. R. WESTCOTT,
Assistant Engineer, Missouri Pacific.

On the Baltimore & Ohio

# NEWS OF THE MONTH

## Crossing Accidents Decline

Fatalities at highway grade crossings in the first nine months of 1930 totaled 1,448, a reduction of 263 as compared with the same period in 1929, according to reports filed by the roads with the Interstate Commerce Commission. The number of persons injured totaled 3,831, a reduction of 853 below 1929.

## State Court Revokes Permit of Highway Operators

In a recent decision, the Supreme Court of Florida revoked a permit which had been granted by the Railroad Commission of that state for the operation of a highway freight line paralleling the Seaboard Air Line between Tallahassee and Jacksonville. In its decision the court said that the basic question was whether "public convenience and necessity . . . could reasonably be construed to require or justify scrapping or serious crippling of railroads of the state where they are already rendering adequate service."

## Waiting Room with a Club Atmosphere

With respect to the arrangement of the seats in the main waiting room of its recently remodeled passenger station at Omaha, Neb., the Chicago, Burlington & Quincy has introduced a decidedly new feature. Instead of the usual rows of conventional benches, the waiting room has been equipped with overstuffed easy chairs and divans, attractively covered with leather and arranged in groups. The club-like atmosphere of the waiting room thus created is enhanced by other attractive furnishings such as rugs and hardwood tables.

## C. P. R. Emqloyees Reduce Hours to Provide Employment

As a means of providing employment for more than 500 train and yard men on the Canadian Pacific, Eastern lines, the Brotherhood of Railroad Trainmen has agreed to reduce the working time of more than 3,100 train and yard men in order to increase the number of employees for whom work is available. The agreement, which was reached several weeks ago between members of the brotherhood and officers of the railway, provides that the working time of yardmen shall be reduced to a maximum of 26 days per month and the mileage of baggagemen and trainmen in proportion.

## November Freight Traffic

Freight traffic transported by the Class I Railroads in November, 1930, totaled 32,295,282,000 net ton-miles, a reduction of 16.6 per cent under the same month in 1929, according to reports compiled by the Bureau of Railway Economics. This figure also represented a reduction of 23.1 per cent under November, 1928. Freight traffic in the first 11 months of 1930 was 393,078,920,000 net ton-miles, a reduction of 13.8 per cent under that of the corresponding period in 1929, and of 10.6 per cent under 1928. The average speed of freight trains in November was 14.1 miles an hour, which was the highest for any corresponding period on record.

## Railway Employment Declines

Class I railways reported to the Interstate Commerce Commission a total of 1,394,403 employees as of the middle of November, which is 17.05 per cent less than in November, 1929, and 17.02 per cent less than in the same month of 1928. This also constitutes a reduction of 60,560 employees from the middle of October, 1930. The maintenance of way and structures group showed a reduction below November, 1929, of 26.74 per cent, which was the greatest reduction shown by any of the groups. According to these reports the total number of railway employees is nearly one-third less than the number in service in November, 1920, when it was 2,068,454.

## More Two-Cent Fares

The inclination toward a two-cents-a-mile railway passenger fare is becoming increasingly evident. The St. Louis-San Francisco has been granted permission by the Interstate Commerce Commission to file tariffs, effective February 1, which will establish a coach fare of approximately two cents a mile between all points on the system and on the Fort Worth & Rio Grande, a subsidiary. In addition, the Missouri Pacific has applied to the Railroad Commission of Texas for permission to establish a passenger rate in rail motor coaches of two cents a mile between Austin, Tex., and San Antonio, 82 miles. The proposal of the St. L.-S. F. is being vigorously opposed by the Missouri Pacific, the Missouri-Kansas-Texas, and the St. Louis Southwestern, which maintain that the two-cent fare is not only unreasonably low, but that it will require similar reductions throughout the Southwest. The protesting roads state that with this low fare it would be necessary to increase coach travel 80 per cent to secure the same gross revenue, and in their opinion this is not possible.

## Northern Roads Abandon Merger Plans

The Northern Pacific and the Great Northern have notified the Interstate Commerce Commission that they have abandoned their attempt to unify the two properties. The I. C. C. previously had authorized the consolidation of these lines on certain conditions, one of which was that the two northern lines dispose of their joint control of the Chicago, Burlington & Quincy. In connection with a circular addressed to depositors of stock of the two companies, Charles Donnelly, president of the Northern Pacific, and Ralph Budd, president of the Great Northern, have made public a joint statement saying that it has not been possible to arrive at a satisfactory plan for segregating the Burlington from the joint owners.

## Highway Transportation

A spirit of intense competition between independent motor coach and motor truck companies and the railroads has been revealed at the hearings which the Interstate Commerce Commission is conducting relative to the co-ordination of railway and highway transportation.

Testimony of railway executives indicates that they are thoroughly in favor of the regulation of highway transportation on the same basis as the railways, in order that the competition between the two forms of transportation may be on a more equitable basis. On the other hand, operators of highway transportation service are distinctly opposed to federal regulation of their activities. It has been revealed at the hearings that the railways own wholly or in part about 20 per cent of the motor coach lines and 10 per cent of the truck lines in the United States. These operations, however, have not been generally profitable

to the railways except insofar as they have eliminated the expense of operating the trains for which the highway service was substituted. The question of store-door collection and delivery is constantly recurring at the hearings, although only a few roads have as yet resorted to this measure as a means of meeting effectively highway competition.

## Traffic in First Quarter to be 5.5 Per Cent Lower

Carload shipments of the 29 principal commodities in the first quarter of 1931 will be approximately 6,658,456 cars, a reduction of 380,607 cars or 5.5 per cent below the corresponding period in 1930, according to the combined reports of the Shippers' Regional Advisory Boards. With the exception of the advisory board of the Pacific Coast region, which covers California, Arizona, Nevada and part of New Mexico, and which expects an increase of 3.8 per cent, all of the 13 boards anticipate a decrease in carloadings for the first quarter of the year. The anticipated decreases range from 1.1 per cent in the Atlantic States to 12.5 per cent in the Pacific Northwest and 12.6 per cent in the Ohio Valley.

## Little Action on Railway Bills

According to reports from Washington, there seems to be little possibility that the various bills involving railway legislation which are now pending before Congress will receive much attention during the present session. So far little action has been taken on the various recommendations in regard to this matter that have been made to Congress, such as that of the Interstate Commerce Commission for the repeal of the recapture clause of the Transportation act, and also the legislative proposals which were adopted by the railway executives at their meeting in New York last November. There are also several important bills involving rate making, bus legislation and railway consolidation on which there is little likelihood of action being taken during this term of Congress.

## Propose Higher Rates for Alaska Railroads

An increase in the passenger rate from 6 to 10 cents per mile, an increase in freight rates sufficient to yield an increase in freight revenue of 50 per cent, and a reduction of 100,000 train-miles a year are among the suggestions made by a Senate committee which was appointed to investigate the affairs of the government-owned Alaska Railroad with a view to seeking means of reducing this road's large annual deficit. The committee was composed of Senators Howell of Nebraska, Kendricks of Wyoming and Thomas of Oklahoma. The present rates were found inadequate in view of the high cost of maintenance, the severe climatic conditions, the small population, which numbers only about 8,400 inhabitants in the 50,000 square miles of territory served by the road, and the lack of outgoing freight. "Looseness and inefficiency in the conduct of the railroad's business" were found also to contribute to the annual deficit.

## Merger Plan Proposed by Eastern Executives

Early in January, after a series of meetings in New York, the executives of the four major eastern railways agreed on a plan for consolidating the roads in the Eastern district into four major systems. Announcement of such a plan at this time was brought about largely through the efforts and influence of President Hoover who is said to be deeply concerned over the railway problem. The conferences were attended by W. W. Atterbury, president of the Pennsylvania, P. E. Crowley, president of the New York Central, Daniel Willard, president of the Baltimore & Ohio, J. J. Bernet, president of the Chesapeake & Ohio, and the Van Sweringen brothers, in addition to other executives of these roads. The plan proposes four eastern systems built around the above named roads instead of five systems as set forth in the consolidation plan of the Interstate Commerce Commission which was announced more than a year ago.

The general plan as to the allocation of the roads into four systems is as follows: To the New York Central—the Delaware, Lackawanna & Western and a direct connection with the Virginian at Deepwater, Va., including joint rates and routes over that line; to the Pennsylvania—the Wabash, the Detroit, Toledo & Ironton and the Norfolk & Western; to the Baltimore & Ohio—the Ann Arbor, the Reading, the Central of New Jersey, the Western Maryland, the Buffalo, Rochester & Pittsburgh, the Buffalo & Susquehanna, the Lehigh & Hudson River and the Chicago & Alton; to the Chesapeake & Ohio-Nickel Plate System—the Erie, the Bessemer & Lake Erie, the Pere Marquette, the Wheeling & Lake Erie, the Chicago & Eastern Illinois and the Lehigh Valley. It is recommended that a number of short lines be assigned to the four systems jointly. This plan has not yet been officially submitted to the Interstate Commerce Commission for approval.

## Bus Operators Declare Publicity Campaign

The National Association of Motor Bus Operators has recently instituted a publicity campaign which is directed mainly in retaliation at the policy of the railways of demanding increased regulation and taxation of automotive vehicles in common carrier service. An official bulletin has been issued declaring that studies are now under way "which will conclusively prove the fact that the automotive vehicle is paying its own highway bill" and that "it is being adequately regulated from every standpoint in every state in the union." The bulletin declares also that "we will not only be able to defend ourselves but, if necessary, be in a position to carry the fight to the railroads if they become active before the different state legislatures in their effort to hamper or discourage the operation of motor buses and motor trucks in common carrier service."

## Tie Purchases Decrease

According to the Bureau of the Census in a preliminary tabulation of data collected in 1930 in co-operation with the Forest Service, Department of Agriculture, 85,662,513 crossties and 315,473,000 ft. b. m. of switch and bridge ties were purchased in 1929 by steam and electric railroads in this country. The number of crossties purchased in 1929 shows a decrease of 17.1 per cent as compared with 1927, while the quantity of bridge and switch ties purchased decreased 9.5 per cent. Steam roads alone purchased 81,341,663 crossties in 1929, as compared with 98,718,389 in 1927, a decrease of 17,376,726 ties or 17.6 per cent. Their purchases of bridge and switch ties in 1929 totaled 302,125,000 ft. b. m., as compared with 318,962,000 ft. b. m. in 1927, a reduction of 16,842,000 ft. b. m., or 5.3 per cent.

## Drought Causes Decrease in River Traffic

The decrease in the traffic handled by the Inland Waterways Corporation in the first nine months of 1930 as compared with the same period of 1929, was attributed to the unprecedented drought by Gen. T. Q. Ashburn, chairman of the board, in testimony before a sub-committee of the House of Representatives appropriations committee. Gen. Ashburn testified that there was a constant increase in the tonnage offered but that at times it was not possible to navigate on the Mississippi river even below St. Louis, Mo., and Memphis, Tenn. According to Gen. Ashburn, the tonnage carried on the lower river in the first nine months of 1930, was 856,308, as compared with 997,573 in 1929, on the Warrior river division it was 158,803 tons in 1930, as against 185,713 in 1929, and on the upper Mississippi it was 84,307 tons as compared with 86,194.

## Mexican Railways to Reorganize

The plan of reorganizing the National Railways of Mexico which has been approved by the Mexican government includes a number of recommendations for important changes of policy in the maintenance of way department. It is planned to intensify the use of creosoted lumber and steel tie plates and to replace rails in the main lines weighing less than 80 lb. per yard with heavier rails. Other recommendations include the reconditioning of the creosoting plant at Acambaro, Gto., to secure a higher degree of preservation of the timber; the acquisition of motor cars for transporting the maintenance of way personnel; the strengthening of all bridges to support heavier locomotives; and the extension of bridges to facilitate drainage as a means of expediting traffic during the rainy season and of reducing damage to roadbed and structures during floods.

# ASSOCIATION NEWS

## Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be held on February 19 at the usual place of meeting, Keen's Chop House, 72 West Thirty-Sixth street, New York City. Following dinner, which will be served at 6:30 p. m., the principal subject for discussion will be "The Safe Operation of Motor Cars."

## National Railway Appliances Association

The National Railway Appliances Association will hold its twenty-third annual exhibit of materials and equipment employed in the construction and maintenance of railway tracks, structures and signals at the Coliseum, Chicago, on March 9-12. All available floor space has already been contracted for by more than 190 companies which will present their exhibits as heretofore.

## International Track Supervisors' Club

The International Track Supervisors' Club will hold its next meeting on February 19 at the Hotel Statler, Buffalo, N. Y. Luncheon will be served at 1 p. m. Eastern Standard Time. The principal business of the meeting will be the presentation of a paper on "Manganese Switch Points" by D. F. Hilton, Ramapo Ajax Corporation, and a paper on "The Maintenance of Frogs and Switch Points," by E. P. Safford, supervisor of track, New York Central.

## Bridge and Building Association

The Executive Committee has appointed the committees to direct the investigation and preparation of reports on subjects selected at the last convention, the chairmen of which are as follows:

Means of Interesting Bridge and Building Employees in Safety Measures—F. H. Masters, assistant chief engineer, E. J. & E., Joliet, Ill.

The Relative Economy of the Various Culvert Materials—Cast Iron, Concrete and Corrugated Iron Pipe and Treated Wood—F. M. Lehrman, bridge draftsman, C. & N. W., Chicago.

The Relative Advantages of Separate as Against Combined Gangs for Bridge and Building Work. Under what Conditions Are Each Advisable?—H. C. Munson, division engineer, C. M. St. P. & P., Sioux City, Iowa.

The Maintenance of Ballast Deck Trestles and Economical Methods for Replacing Individual Piles, Caps or Stringers—H. I. Benjamin, assistant bridge engineer, S. P., San Francisco, Cal.

The Relative Merits of Inside Metal and Outside Wooden Guard Rails. Are Both Necessary? Can a Satisfactory Method be Developed for Spacing Ties and Fastening the Wooden Floor to the Structure Which Will Make the Wooden Guard Rail Unnecessary? If so, is There Any Other Advantage in Eliminating the Wooden Guard Rail—C. A. J. Richards, assistant engineer, Penna., Chicago.

The Possibility of Standardizing Materials Used in Railway Water Service—M. M. Munson, inspector water service, M. P., Kansas City, Mo.

The Comparative Cost, Durability and Protective Value of Brush and Spray Painting—C. M. Burpee, purchasing engineer, D. & H., Albany, N. Y.

High Early Strength Concrete—Its Place in Bridge and Building Work—L. B. Alexander, assistant bridge engineer, M. C., Detroit, Mich.

## Maintenance of Way Club

"Japan and the Japanese Railways" was the topic for discussion at the meeting of the club on Wednesday evening, January 21, which was attended by 71 members and guests. The speaker of the evening was Louis Yager, assistant chief engineer of the Northern Pacific, who gave a general talk on the political, social and economic aspects of Japan, in their relation to the Japanese railways. This talk was followed by a showing of some moving pictures of Japanese track maintenance methods, which had been presented to the A. R. E. A. by the Japanese Government.

The next meeting of the club will be held on Wednesday evening, February 18, in the ball room of the Auditorium hotel, commencing with a dinner at 6:30 p. m. The name of the speaker will be announced later.

## American Railway Engineering Association

At a meeting in Chicago on January 6, the board of directors voted to hold the annual convention on the dates originally selected, but to reduce it from a three-day to a two-day meeting. The convention will, therefore, be held at the Palmer House, Chicago, on March 10 and 11. The banquet normally held on the evening of the second day will be omitted. Three sessions will be held on the first day, convening at 9:30 a. m., 2:30 p. m. and 7:30 p. m. On the second day the meeting will be called to order at 9 a. m. and will adjourn late that evening. There will be no curtailment in the number of committee reports presented or in the manner of their presentation, as it is desired that they be discussed from the convention floor in the thorough manner that has long characterized the work of this organization.

Bulletins No. 329, 330 and 331 containing the reports of 13 of the standing and special committees have already been distributed to the members. Three additional bulletins containing the remainder of the committee reports will be mailed during February.

By recent action, the American Railway Association has appropriated $25,000 annually for a period of five years for use, together with a similar appropriation from the rail manufacturers, for an exhaustive investigation of transverse fissures. The final details of this cooperative arrangement are now being perfected with the expectation that work on the investigation will start in the spring.

Among the committees which met during January were the Arrangements committee at Chicago on January 6, the Roadway committee in the same city on January 12, the Track and Masonry committees at Chicago on January 14, the Yards and Terminals committee at Pittsburgh on January 19 and the Committee on Records and Accounts in the same city on January 27.

## The Roadmasters Association

The Executive committee of the Roadmasters' Association has appointed the following men as chairmen of committees to investigate and report at the next convention on subjects selected at the last annual meeting:

Failed Rails, Their Cause, Detection and Disposition—J. B. Martin, general inspector of track, N. Y. C., Cleveland, Ohio.

The Protection of Track Men Working Under Traffic, Especially in Multiple Track Territory and When Using Noise-Making Equipment—R. H. Carter, supervisor, I. C., Chicago, Ill.

Water Pockets, Their Cause and Cure—M. H. Murphy, roadmaster, C. & A., Slater, Mo.

Routine Track Inspection, Its Purpose, Scope and Value—M. Canavan, general roadmaster, U. P., Cheyenne, Wyo.

Methods of Handling Snow and Ice on Railroads, Including the Drainage of Switches and Other Track Structures Where Snow-melting Devices are Used—J. J. Davis, supervisor, E. J. & E., Joliet, Ill.

## B. & O. Man to Modernize Russian Railways

The Russian government has selected C. A. Gill, superintendent of motive power of the Eastern lines of the Baltimore & Ohio, to take direct charge of the modernization of all steam transportation systems in the Union of Socialist Soviet Republics. Mr. Gill will sail for Russia about February 1, and will be accompanied by a staff of American railway experts representing practically all branches of the industry. Coincident with Mr. Gill's appointment and as a means of improving railway transportation, the Russian authorities have taken the drastic step of requiring all state department employees with railway experience to report within 15 days to government labor exchanges where they are to be assigned to railway duties.

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CALCIUM CHLORATE

*It is uneconomical to let clean track get back into weedy condition.*

*Maintain a clean track. Don't let weeds become established. It is the cheapest as well as most satisfactory policy.*

# What Authorities Say About Chemical Weed Killing

"The permanency of results of chemical weed killing as reported seems to warrant the conclusion that it is the most effective of any method. On roads where this method has been in use for several successive seasons, the vegetation appearing each year seems to be less and the cost of treatment materially decreases. It is thought that continued treatment may render ballast and embankment highly sterile, and thus discourage the growth of vegetation."

*Published from Report of Roadway Committee, A.R.E.A., Nov., 1929 A.R.E.A. Bulletin.*

"The opinion of this committee is that chemical treatment offers the best method of weed control and elimination in the roadbed section. It is economical, rapid and effective. It gives cleaner track over a longer period than any other method and does not interfere with other maintenance work during application. The lasting results permit the section forces to be utilized on important track work instead of controlling weeds, which is reflected in better track condition."

*From Report of Weed Control and Elimination Committee, Roadmasters' and Maintenance of Way Ass'n., 1929.*

The results of chemical weed killing treatment are cumulative. Vegetation gets less each year and the cost of treatment decreases annually. To let track go a year or two without treatment will undo the fine work already accomplished. Weed killing is a necessity. Don't neglect it for a temporary saving that will penalize you later many times over in increased maintenance costs.

**Chipman Chemical Engineering Co. Inc.**
**BOUND BROOK, N. J.**
Chicago, Ill. Palo Alto, Cal. Houston, Tex. Atlanta, Ga. Kansas City, Mo. Winnipeg, Man.

# PERSONAL MENTION

## General

**J. C. White,** division engineer of the New York division of the Pennsylvania, with headquarters at Jersey City, N. J., has been promoted to superintendent of the Monongahela division, with headquarters at Uniontown, Pa.

**M. D. Bowen,** system welding foreman of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Chicago, has been promoted to superintendent of work equipment and welding, with the same headquarters, to succeed **J. M. Hayes,** deceased.

**William E. Smith,** assistant general manager of the Louisville & Nashville, with headquarters at Louisville, Ky., and formerly a track supervisor and roadmaster on that road, has been promoted to general manager with the same headquarters.

**N. B. Pitcairn,** general superintendent of the Eastern Ohio division of the Pennsylvania at Pittsburgh, Pa., and formerly a division engineer on that road, has been elected president of the Detroit, Toledo & Ironton, with headquarters at Detroit, Mich. Mr. Pitcairn

**N. B. Pitcairn**

was born on November 8, 1881, at Harrisburg, Pa., and was educated at Princeton University. He entered railway service on June 29, 1901, as a rodman in the engineering department of the Pennsylvania, serving consecutively to November 9, 1919, as a rodman in the office of the chief engineer, transitman, assistant supervisor and supervisor at various points. On November 10, 1919, he was appointed division engineer on the Pittsburgh division. In 1920 he was transferred to the Middle division and in July, 1922, he was further transferred to the New York division. In October, 1923, Mr. Pitcairn was appointed superintendent of the Erie & Ashtabula division, later serving in the same capacity on the Middle division and the New York division. In July, 1928, he was promoted to general superintendent of the Eastern Ohio division, which position he was holding at the time of his recent election as president of the D. T. & I.

**A. G. Neighbour,** bridge architect on the Central Railroad of New Jersey, with headquarters at Jersey City, N. J., has been appointed chief material inspector, succeeding **S. G. Henry,** deceased.

**Robert L. Pearson,** chief engineer of the New York, New Haven & Hartford, was promoted to assistant general manager, effective January 1. Mr. Pearson was born on April 2, 1882, at Philadelphia, Pa. He was educated at Swarthmore College and entered railway service in June, 1903, as a transitman for the American Railways Company. He entered the service of the New Haven in 1904 as an inspector in the construction department, being appointed a transitman in that department later in the same year. In 1907, he was transferred to the maintenance department in the same capacity. In October, 1908, Mr. Pearson was appointed assistant engineer and in September, 1914, he became track supervisor. Two years later he was appointed division engineer in the maintenance department. From October, 1917, to September, 1918, Mr. Pearson was with the U. S. Shipbuilding Company at Hog Island, returning to the New Haven on the latter date as division engineer. He also served in the same capacity on the Central New England Railroad, a subsidiary of the New Haven. He was appointed maintenance engineer for these two roads in 1921, and in 1923 he was advanced to the position of engineer maintenance of way, holding that post until October, 1929, when he was promoted to chief engineer, the position he was holding at the time of his recent promotion to assistant general manager.

**Robert L. Pearson**

## Engineering

**F. H. Hibbert,** engineer of the Quebec Central, has had his title changed to chief engineer, with headquarters at Sherbrooke, Que.

**S. T. W. Green** has been appointed valuation engineer and real estate agent of the Lehigh & New England Railroad, with headquarters at Bethlehem, Pa.

The headquarters of **C. R. Wright,** district engineer of the Lake Erie & Western district of the New York, Chicago & St. Louis, have been moved from Indianapolis, Ind., to Frankfort.

**T. Martin,** division engineer of the Portage division of the Canadian Pacific, with headquarters at Winnipeg, Man., has been appointed assistant engineer in charge of construction on the False Creek-Burrard Inlet tunnel at Vancouver, B. C. **V. H. Carruthers,** roadmaster at Weyburn, Sask., has been promoted to division engineer of the Portage division succeeding Mr. Martin.

**J. R. Nagel,** division engineer of the Missouri division of the Missouri Pacific, with headquarters at Poplar Bluff, Mo., has also been appointed division engineer of the St. Louis Terminal division with headquarters at St. Louis, Mo., to relieve **W. A. Kennon,** who has been granted a leave of absence because of illness. The position of division engineer at Poplar Bluff, formerly held by Mr. Nagel, has been abolished.

**D. M. Howard,** supervisor on the Panhandle division of the Central region of the Pennsylvania, has been promoted to assistant division engineer on the Philadelphia Terminal division, to succeed **J. S. Gillum,** who has been promoted to division engineer of the Erie & Ashtabula division, with headquarters at New Castle, Pa., where he succeeds **C. W. VanNort,** whose transfer to Pittsburgh, Pa., was noted in the January issue. A complete sketch of Mr. Gillum's career appeared on page 280 of the June, 1930, issue of *Railway Engineering and Maintenance.*

**E. E. Oviatt,** engineer maintenance of way of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been promoted to chief engineer with the same headquarters, succeeding **R. L. Pearson,** whose promotion to assistant general manager is noted elsewhere in these columns. **A. L. Bartlett,** maintenance engineer at New Haven, has been promoted to engineer maintenance of way to succeed Mr. Oviatt. **W. T. Dorrance,** designing engineer, with headquarters at New Haven, has been promoted to assistant to chief engineer.

Mr. Bartlett was born on November 22, 1884, and entered railway service as a transitman on the Northern Pacific in 1909. A year later he resigned to enter

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THE UNIT ANTI-CREEPER is a one-piece anchor of the latest design. Its holding power is more than sufficient to withstand the severest service strain to which it may be subjected.

It is easily applied and removed.

It will not loosen and become inoperative when the rails slack back.

It will carry the tie in any kind of ballast without slipping.

It can be re-applied any number of times.

*The only one-piece anchor with a take-up.*

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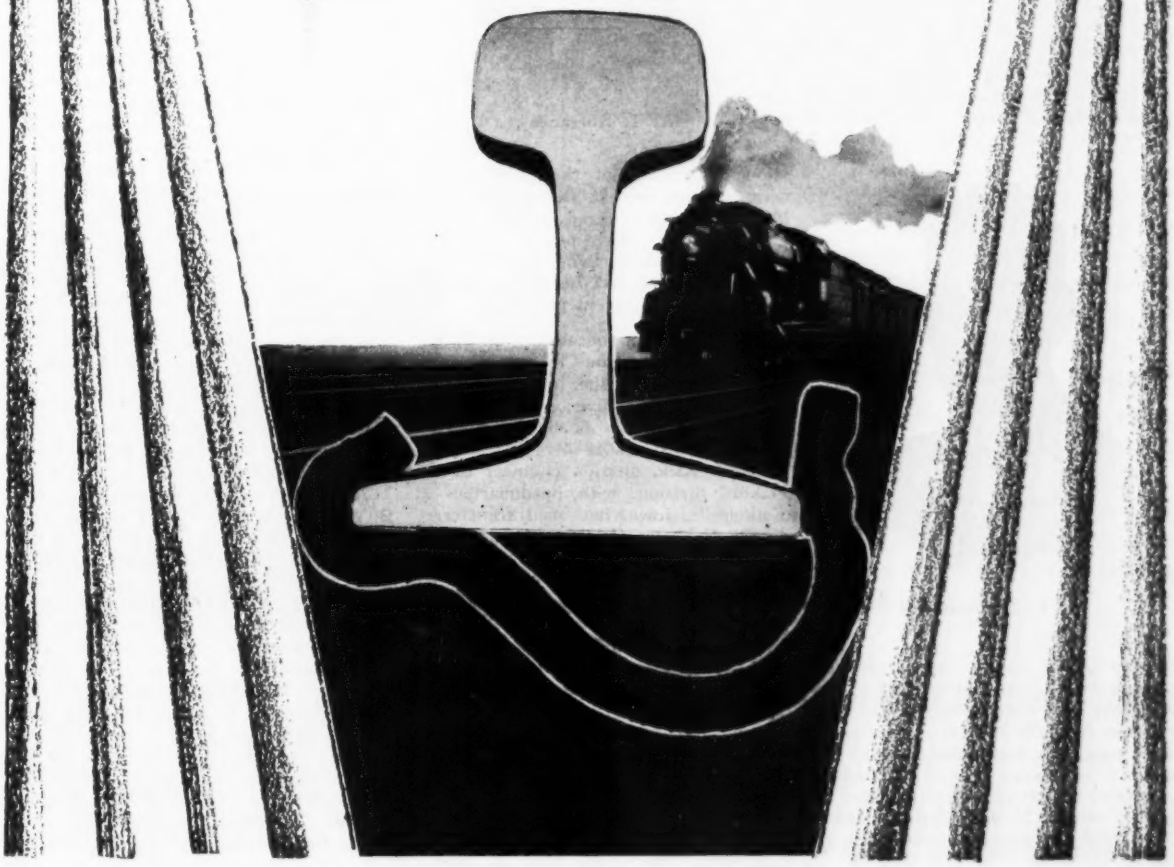


the service of the United States government, where he remained until January, 1912, then going with the New Haven as a transitman. In 1914 he was promoted to assistant engineer at New Haven,

A. L. Bartlett

Conn., being subsequently advanced through the positions of general foreman and track supervisor. In June, 1919, after serving for two years with the United States Army Engineers, part of the time as a captain, he returned to the New Haven as assistant division engineer of the Danbury division. In 1923, Mr. Bartlett was promoted to division engineer of the Boston division, being transferred to the New Haven division in November, 1928. In October, 1929, he was promoted to maintenance engineer, which position he held until his recent promotion.

Mr. Oviatt was born on July 13, 1891, and graduated from Sheffield Scientific School, Yale University, in 1913 with a degree in civil engineering. He entered

E. E. Oviatt

railway service in the same year as a rodman on the New Haven and has been with that road continuously to the present. On April 30, 1915, after serving for some time as a transitman, he was promoted to assistant engineer, valuation. A year later he was appointed assistant engineer on the Midland division and in May, 1917, he was appointed track supervisor on the Boston division. In April, 1918, Mr. Oviatt was promoted to division engineer of the Old Colony division, being in January, 1920, transferred to the Danbury and Central New England divisions, and in February, 1921, to the New Haven and New London divisions. On December 1, 1923, he was promoted to maintenance engineer, which position he held until October, 1929, when he was promoted to engineer maintenance of way, holding this position until recent promotion to chief engineer.

Mr. Dorrance is a graduate of Brown and Massachusetts Institute of Technology and commenced his railway career as a rodman on the South Station construction work in Boston, Mass. Subsequently he served with the Buffalo, Rochester & Pittsburgh, the New York Central, and with the East Boston Company, a terminal railroad project. In 1915, he became connected with the valu-

W. T. Dorrance

ation department of the New Haven, with headquarters at Boston. In July, 1916, he was transferred to New Haven, Conn., as chief draftsman in the engineering department, being appointed designing engineer in 1920, which position he held until his recent promotion.

Coincident with the absorption of the Dakota division of the Chicago, Rock Island & Pacific by the Iowa and Cedar Rapids-Minnesota divisions, now known as the Iowa-Minnesota division and the Cedar Rapids-Dakota division, respectively, **F. Kirk,** division engineer of the Dakota division, with headquarters at Estherville, Iowa, has been transferred to the Nebraska-Colorado division, with headquarters at Fairbury, Neb., succeeding **T. P. Warren,** who has been assigned to other duties. **W. E. Heimerdinger,** division engineer of the former Cedar Rapids-Minnesota division, with headquarters at Cedar Rapids, Iowa, has had his jurisdiction extended to include the entire Dakota division. **A. C. Bradley,** division engineer of the former Iowa division with headquarters at Des Moines, Iowa, has had his jurisdiction extended to include that part of the former Cedar Rapids-Minnesota division between Des Moines and St. Paul, Minn. **C. P. Richardson,** engineer track elevation, with headquarters at Chicago, has also been appointed division engineer of the Chicago Terminal division, succeeding **D. Ruhl,** who has been transferred. **S. L. McClanahan,** trainmaster, with headquarters at Chickasha, Okla., has been appointed division engineer of the Arkansas-Louisiana division, with headquarters at Little Rock, Ark., to succeed **F. P. Funda,** who has been transferred. **F. W. Thompson,** division engineer at Rock Island, Ill., has had his jurisdiction extended to include the Peoria terminal.

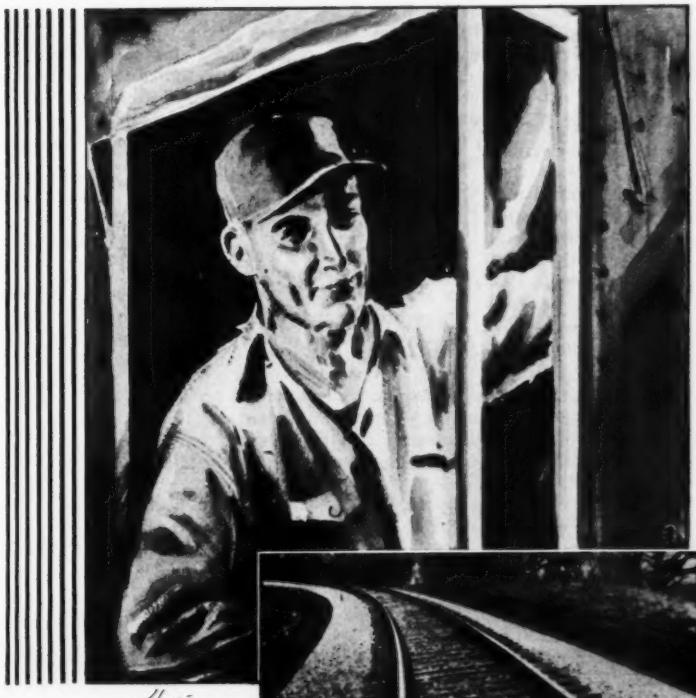
## Track

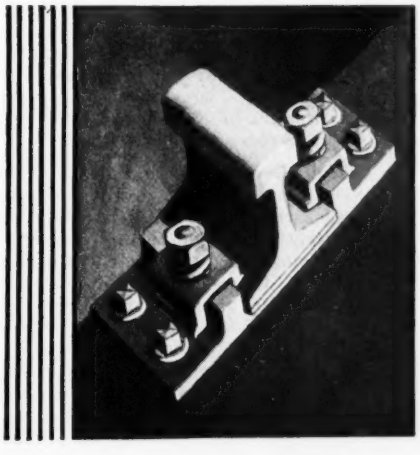
**A. E. Dube** has been appointed district road master on the Great Northern, with headquarters at Larimore, N. D., succeeding **Peter Skurdahl,** who has retired.

**J. Rogiani** has been appointed roadmaster on the Regina division of the Canadian Pacific, with headquarters at Weyburn, Sask., succeeding **V. H. Carruthers,** whose promotion to division engineer is noted elsewhere in these columns.

**J. E. O'Brien,** roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Peoria, Ill., has been transferred to Oskaloosa, Iowa, succeeding **H. G. Dennis,** who has been assigned to other duties. **M. Bootjer,** roadmaster at Manley, Iowa, has been appointed acting roadmaster with the same headquarters. **J. Colles,** roadmaster at Dows, Iowa, has been transferred to Manley, to succeed Mr. Bootjer, but is temporarily serving as roadmaster at Estherville, Iowa, where he is relieving **J. Peterson,** who has been granted a 90-day leave of absence because of illness. **James Archer,** roadmaster at Fairbury, Neb., has been transferred to Belleville, Kan., to succeed **J. Christenson,** who has been transferred to Goodland, Kan., where he replaces **R. A. Brown,** acting roadmaster, who has been appointed assistant engineer at Fairbury. The position of roadmaster at Fairbury formerly held by Mr. Archer, has been abolished and the territory has been divided between **C. Kelley,** roadmaster at Fairbury, and Mr. Archer. **C. B. Teller,** roadmaster at Armourdale, Kan., has been assigned to other duties and his position abolished. This territory has been divided between **V. B. Simpson,** roadmaster at Herington, Kan., and **J. A. Trainer,** roadmaster at Pleasant Hill, Mo. **B. Wright,** roadmaster at Herington, has been assigned to other duties and his position abolished. **W. A. Simpson,** roadmaster at Herington, and **S. P. Jones,** roadmaster at Wichita, Kan., have had their jurisdiction extended to include the territory formerly held by Mr. Wright. **J. E. Crawford,** roadmaster at Pratt, Kan., has been transferred to Dalhart, Tex., to succeed **C. F. Longerbeam,** who has been assigned to other duties. **T. H. Bilbrey,** roadmaster at El Reno, Okla., has been appointed acting roadmaster at Geary, Okla., to relieve **B. F. Wright,** who has been granted a leave of absence. **M. C. Groseclose,** roadmaster at Wauri-

"I CAN TELL THE SECOND WE RUN ONTO THE GEO





A group of men were inspecting a one-mile test section of G E O track construction. A north-bound freight thundered by. There was practically no wave motion in the rail. A short time later another freight train came along and stopped because of a hot box on one of the freight cars. The engineer leaned from the cab window.

"What do you think of this new track?" one of the men asked him.

"Never saw anything to beat it," he replied. "It's smooth riding and seems to be a lot stronger. I can tell the second we run onto the G E O."

This incident is indicative of the opinion in which G E O track construction is held by those familiar with it. Carnegie Steel Company is the sole manufacturer and distributor of G E O track materials in America. Descriptive literature on request.

GEO TRACK CONSTRUCTION

CARNEGIE STEEL COMPANY - PITTSBURGH

*Subsidiary of United States Steel Corporation*

106

ka, Okla., has been assigned to other duties and his position abolished and **W. M. Emmonds,** roadmaster at Winnfield, La., has also been assigned to other duties and his position abolished.

**F. H. DeMoyer,** assistant supervisor on the New York zone of the Pennsylvania, has been promoted to supervisor on the Monongahela division of the Central region, with headquarters at Uniontown, Pa., succeeding **D. E. Rudisill,** who has been transferred to the office of the chief engineer located at Philadelphia, Pa. **C. D. Merrill,** assistant supervisor at North Philadelphia, Pa., has been promoted to supervisor, with headquarters at Wilkes-Barre, Pa., succeeding **A. H. Whisler,** who has been transferred to Millersburg, Pa. **O. N. Essex,** assistant supervisor, with headquarters at Huntingdon, Pa., has been transferred to Downington, Pa., where he succeeds **A. H. Stimson,** who has been transferred to North Philadelphia to succeed Mr. Merrill. **G. B. Adelman,** assistant on the engineer corps, with headquarters at Chester, Pa., has been promoted to assistant supervisor, with headquarters at Norristown, Pa., to succeed **R. DeJaiffe,** who has been transferred to Pottsville, Pa., where he, in turn, succeeds **J. G. Copley.** Mr. Copley has been transferred to Parkton, Md., to succeed **M. S. Smith,** who has been transferred to Lemoyne, Pa., where he succeeds **D. E. Smucker.** Mr. Smucker has been transferred to Washington, D. C., to succeed **H. F. Webber,** who has been transferred to Tyrone, Pa. Mr. Webber succeeds **C. R. Bergman,** who has been transferred to Chester, Pa., where he succeeds **P. M. Roeper,** who has been transferred to Newport, Pa. Mr. Roeper succeeds **J. L. Hitz,** who has been transferred to West Philadelphia, Pa., succeeding **K. A. Werden,** who has been transferred to Huntingdon, Pa., to succeed Mr. Essex. **James McCoy,** supervisor in the office of the chief engineer maintenance of way of the New York zone, has retired.

## Bridge and Building

**J. W. McCarl,** whose promotion to supervisor of bridges and buildings on the Chicago & North Western, with headquarters at Winona, Minn., was noted in the January issue, was born in March, 1880, at Hokah, Minn., and graduated from the public schools of Winona in 1897. He entered railway service in 1897 as a machinist apprentice on the North Western, but resigned in 1900 to become connected with a concern which was installing water service facilities on the Chicago Great Western between Fort Dodge, Iowa, and Council Bluffs. Mr. McCarl returned to the North Western in 1902, and has been connected with that road continuously to the present.

**Lloyd Castagneto,** whose promotion to bridge and building supervisor on the Oregon Short Line, with headquarters at Nampa, Idaho, was noted in the January issue, was born on February 3, 1892, at Valley, Neb., and was educated in the public schools of Ontario, Ore. He entered railway service in November, 1912, as a bill clerk on the Idaho division of the Oregon Short Line, serving in this capacity and as a warehouse foreman until May, 1913, when he resigned to enter the contracting business. Fifteen months later he re-entered the service of the O. S. L. as a carpenter, being, in September, 1917, appointed traveling carpenter. In August, 1922, Mr. Castagneto was promoted to bridge and building foreman, and in May, 1926, he was further promoted to bridge and building supervisor. In January, 1929, this position was abolished and he was appointed assistant bridge and building supervisor, which position he held until his recent promotion, effective December 1, 1930.

**Henry G. Dalton,** whose promotion to engineer of buildings of the Chicago, Burlington & Quincy, with headquarters in Chicago, was noted in the January issue, has been connected with that railroad for 26 years. He was born at Aurora, Ill., and prior to entering the service of the Burlington in December, 1904, he served successively as an engineer for

Henry G. Dalton

the Link Belt Company at Chicago, the Western Electric Company at Chicago, the Galland-Henning Company at Milwaukee, Wis., and the Fred W. Wolf Company at Chicago. His first experience with the Burlington was in the engineering department. He became assistant engineer of buildings, with headquarters at Chicago, in 1918. Mr. Dalton's promotion to engineer of buildings became effective on December 20, 1930.

## Obituary

**C. H. Mills,** retired master carpenter on the Peoria branch of the Pennsylvania, died at his home in Decatur, Ill., on December 10, at the age of 67 years.

**C. A. Haggerty,** supervisor on the New York, New Haven & Hartford, with headquarters at Stamford, Conn., died at his home in Darien, Conn., on January 8.

**Isaac Garrison,** supervisor of bridges and buildings of the Chesapeake & Ohio, with headquarters at Richmond, Va., died on November 26, at the age of 79 years. Mr. Garrison was born on October 21, 1851, near Batesville, Va. and entered railway service with the C. & O. on May 1, 1875, as a carpenter, with headquarters at Charlottesville, Va. Shortly thereafter he was made foreman, and on August 14, 1885, he was promoted to supervisor of bridges and buildings, which position he was holding at the time of his death.

**Fountain Rice,** former engineer maintenance of way of the National of Mexico, died at his home at Spring Hill, Tenn., on December 19, at the age of 63 years.

**Warren H. Knowlton,** formerly assistant chief engineer of the Chicago Great Western and at one time principal assistant engineer of the New York Central, died on January 3, at Denver, Colo., at the age of 83 years.

**P. J. Barlow,** whose retirement as supervisor of bridges and buildings on the Chicago & North Western, with headquarters at Winona, Minn., was noted in the January issue, died on December 29 after an illness of several months.

**Herbert P. Taussig,** former chief engineer of the Terminal Railroad Association of St. Louis and a number of terminal railroads at St. Louis, Mo., which are now a part of that company, died at St. Louis on December 21, at the age of 76 years. Mr. Taussig was chief engineer of the Terminal Association for a number of years prior to 1895, when he resigned to engage in consulting engineering practice. He was in charge of the design and construction of the Union station at St. Louis.

**William Harold Speirs,** assistant engineer on the Delaware, Lackawanna & Western, died on January 20, at the age of 51. Mr. Speirs was born at Peoria, Ill., in 1880 and graduated from Lehigh University in 1899. He began work in the engineering department of the Delaware, Lackawanna & Western as a draftsman on the Newark track elevation work in 1902, and in 1905 was promoted to assistant engineer, serving in that capacity, in charge of a large number of major improvement projects in the New York suburban zone, until his death.

**Walt Dennis,** superintendent of the New Jersey, Indiana & Illinois, with headquarters at South Bend, Ind., and formerly principal assistant engineer of the Wabash, died at Kansas City on December 6. He was born at Alliance, Ohio, in 1879, and graduated from the University of Kansas in 1900. He entered railway service immediately as an axman in the maintenance of way department of the Kansas City Southern. From 1902 to 1917, Mr. Dennis served successively as a bridge draftsman for Waddell & Hedrick, Kansas City, Mo., on location and construction of the Kansas City, Mexico & Orient (now part of the Atchison, Topeka & Santa Fe), chief delineator on construction on the Union Pacific, with Horace G. Burt, consulting engineer, and as construction engineer, special engineer and assistant engineer on special investigation on the Chicago, Rock Island & Pacific. He was then appointed principal assistant engineer of the Wabash at St. Louis, Mo., where he

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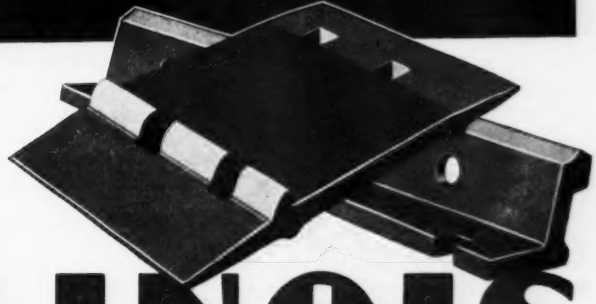

# ILLINOIS

## TIE PLATES AND ANGLE BARS

Illinois Steel Company

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remained until he served during the World war as a major in the construction division of the United States Army. Mr. Dennis returned to the Wabash in November, 1918, as division engineer at Moberly, Mo., being promoted to superintendent of the New Jersey, Indiana & Illinois, a subsidiary of the former road, in October, 1921.

**H. E. Allen,** superintendent of the Dakota division of the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, and formerly general roadmaster on the Fort Worth & Denver City, died on December 23. He was born at Hamilton, Mo., on December 14, 1869, and served in the maintenance of way and engineering departments of a number of western roads including the Atchison, Topeka & Santa Fe, until 1914 when he went with the Rock Island.

**Edward C. Carter,** retired chief engineer of the Chicago & North Western, died at his home at Evanston, Ill., on December 23 of double pneumonia. He was born on January 11, 1854, at Waverly, Ill., and was educated at Rensselaer Polytechnic Institute, Troy, N. Y. Mr. Carter entered railway service in 1870 as

**Edward C. Carter**

a rodman on the Jacksonville & Southeastern, and a year later he went with the Cairo & St. Louis as a rodman-leveler. In 1876 he became a draftsman and mechanical engineer with the Springfield Iron & Steel Co., and in 1877 he returned to railway service as an assistant engineer on the Chicago & Alton. In 1878 Mr. Carter was engaged in Mississippi River observations with the United States government, and from 1879 to 1880 he was assistant engineer of construction of the Indianapolis, Decatur & Springfield. In the latter year he was appointed resident engineer on the Wabash, St. Louis & Pacific (now the Wabash), becoming assistant to the chief engineer in 1884. In 1885 Mr. Carter again left railway service to become assistant and contracting engineer with the Detroit Bridge & Iron Works. In 1887 he was appointed principal assistant engineer of the North Western, being promoted to chief engineer in December, 1899. Mr. Carter held this position until his retirement in 1914.

# SUPPLY TRADE NEWS

## General

**The American Chain Company, Inc.,** moved its Boston (Mass.) office from 132 High street to the Statler building on January 5.

**The Hobbs-Western Company,** St. Louis, Mo., has been organized to conduct the business formerly handled by the **Western Tie & Timber Co.,** and the **Hobbs Tie & Timber Co.**

**The Industrial Brownhoist Corporation** will consolidate the Cleveland, Ohio, and Bay City, Mich., manufacturing operations of the company, in one plant at the latter point as soon as conditions will permit. The general offices, including the administration, financial, sales, purchasing, accounting and part of the engineering departments will be retained at Cleveland.

**The Milwaukee Electric Crane & Hoist Corporation,** which has been operated as a subsidiary of the **Harnischfeger Corporation** since 1928, has been consolidated with the parent company and is being operated as the Milwaukee division. **D. E. Patterson,** general manager of the former corporation and vice-president of the Harnischfeger Sales Corporation, is in charge of the crane and hoist sales.

## Personal

**Otis B. Duncan,** railroad and industrial supplies, Chicago, has moved his office to One North La Salle Street.

**Roland N. Jessop** has been appointed assistant sales manager of the **Ohio Electric Manufacturing Company,** Cleveland, Ohio.

**H. E. Passmore** has been appointed assistant to the president of the **Verona Tool Works,** with headquarters at Oakmont, Pa.

**G. H. Waite,** a representative of the **American Steel & Wire Co.,** has been promoted to manager of sales, with headquarters as before at Kansas City, Mo.

**M. D. Miller,** president of the **Railroad Water & Coal Handling Company,** Chicago, has also been elected vice-president of the **T. S. Leake Construction Company,** Chicago.

**L. F. Rains,** vice-president of the **Columbia Steel Corporation,** has been elected president of the **A. M. Byers Company,** Pittsburgh, Pa., to succeed **Addison H. Beale,** deceased.

**Walter Harnischfeger,** vice-president of the **Harnischfeger Corporation,** Milwaukee, Wis., has been elected president and treasurer to succeed **Henry Harnischfeger,** deceased. **Carl Haugaard** has been appointed assistant treasurer.

**Chester Coulter,** formerly assistant district sales manager for the **Bucyrus-Erie Company,** has been appointed district manager in the Pacific Northwest for the **Northwest Engineering Company,** Chicago. Mr. Coulter will be located at 818 First avenue South, Seattle, Wash.

**B. B. Brewster,** inter-mountain manager of the **Sullivan Machinery Company,** with headquarters at Salt Lake City, Utah, has been appointed manager of the territory comprising Illinois, Indiana and Kentucky, with headquarters at St. Louis, Mo. and Mt. Vernon, Ill. Mr. Brewster is succeeded by **O. S. Neslage,** manager, with headquarters at Mexico City, D. F.

**F. W. Deppe,** district sales representative at St. Louis, Mo., of the **Reading Iron Company,** Reading, Pa., has been appointed general manager of sales with offices at 230 Park avenue, New York. **James K. Aimer** has been appointed assistant general manager of sales in charge of railroad, locomotive and car equipment sales, also bar iron and billets sales. Mr. Aimer's headquarters are also at New York.

**T. S. Leake,** who retired as president of the T. S. Leake Construction Company, Chicago, in February, 1925, died suddenly on January 9, at San Diego, Cal.

**George A. Ferguson,** senior member of the Ferguson & Edmondson Company, railroad contractors, Pittsburgh, Pa., died at his home in Shinnston, W. Va., on December 21, at the age of 66 years.

**J. R. Fleming,** president J. R. Fleming & Sons Company, and vice-president of the Fleming Company, Scranton, Pa., manufacturers of the Mack switch point protectors, died recently at his home in Scranton.

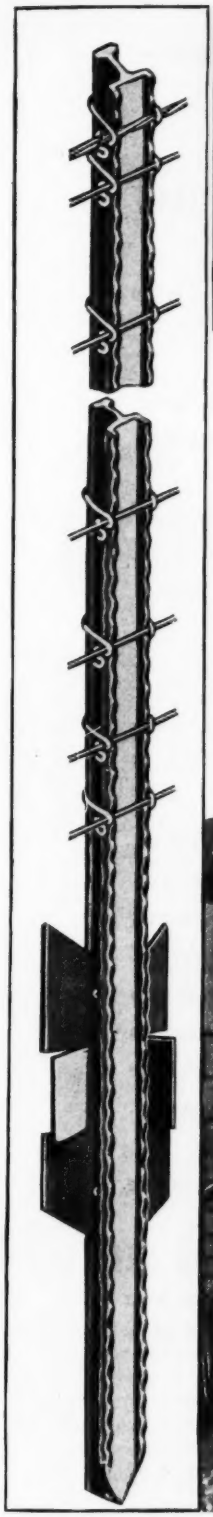
## Trade Publications

**Hackman Trackliner** — The Hackman Trackliner Company, Chicago, has recently issued a folder containing descriptions of the two latest models of the Hackman trackliner.

**A Full-Revolving Shovel.**—The Bucyrus-Erie Company, South Milwaukee, Wis., has published a 24-page booklet describing and illustrating this company's 120 B, 4-cu. yd. electric or steam, full-revolving shovel.

**Hoists and Derricks**—The Clyde Iron Works, Duluth, Minn., has issued a 20-page booklet illustrating the manner in which a number of roads are employing the various types of hoists and derricks manufactured by this company.

**Armco Plates.**—"Pure Iron Plates for Long Service" is the title of a 20-page booklet issued by the American Rolling Mill Company, Middletown, Ohio. This booklet contains general and specific information on plates for a wide range of uses.



# AMERICAN Fence and BANNER STEEL POSTS

IT is cheaper to put up a good fence than to pay stock claims. Likewise it is economy to buy adequate protection—proved protection—such as that offered by American Railroad Fence and Banner Steel Line Posts—the post of railroad rail construction. These products including National Expanding Anchor End and Corner Posts meet every specification recommended by the American Railway Engineering Association.

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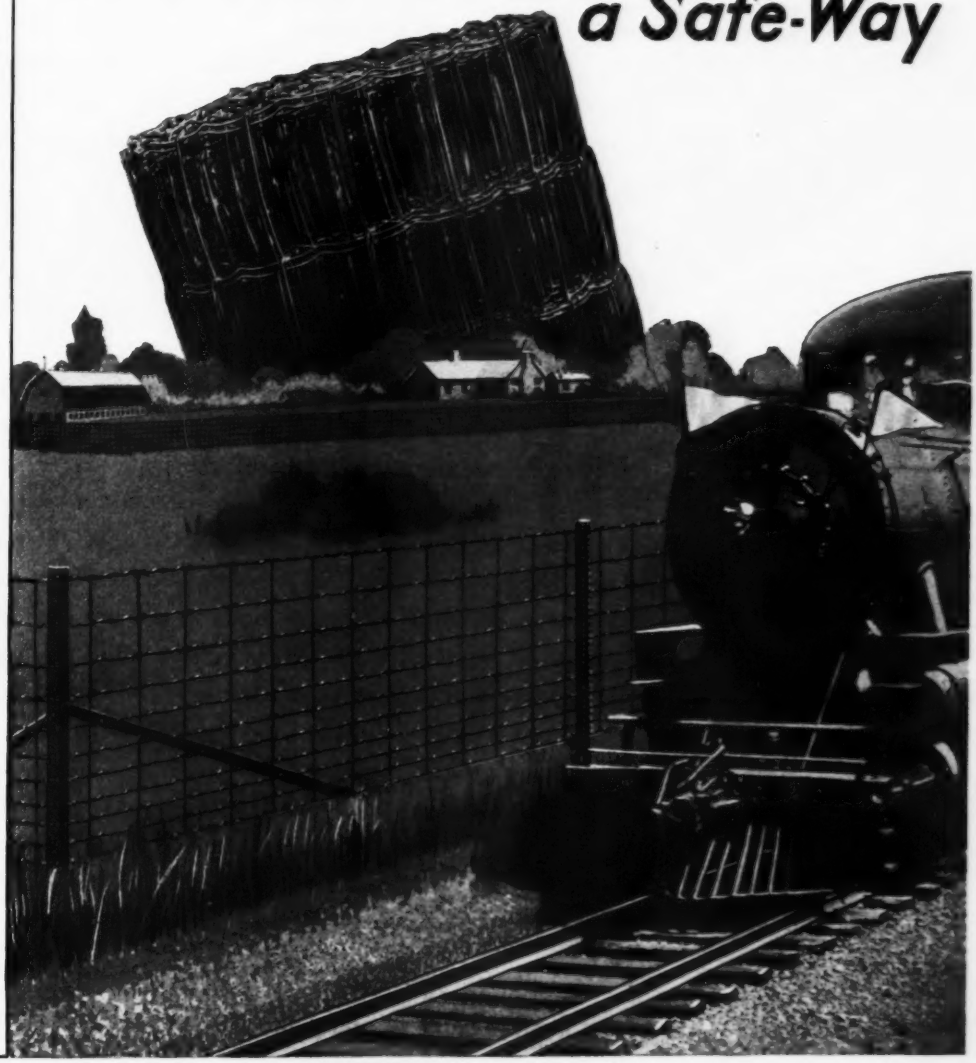

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# *Two Kinds of Editors—*

## bring you the news you read in your Business Paper . . .

TWO KINDS of news go into a business paper. One kind is the news that you read in the editorial pages—news of new ideas, new practices and plans.

The other is the news you need in the advertising pages—news that tells you what to buy to put those plans into effect, news that tells you where to buy it and whom to buy it from.

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TWO KINDS of men MAKE your business paper. One is the editor, interpreting to YOU the news of your business or industry.

The other is the advertising representative, interpreting YOU and YOUR NEEDS to those in position to serve you. He studies as a group, readers of the paper he represents. Then he goes to the makers of merchandise and machinery, of supplies and equipment. He tells them what YOU want to know about the things THEY have to sell. He guides them in presenting the NEWS of their products or their services. He helps them to sell efficiently. He helps you to buy intelligently. He renders an important service to them and to you.

If you are a reader and a buyer, profit by the news in the advertising pages of your business paper.

If you are a reader with something to sell, profit by the service of the advertising representative. Let him show you how to reach a rich, responsive, SELECTED market for your product through the pages of the business press.

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Railway men have been quick to see that the recently announced "Sheffield No. 46" fills a real need. This car is easy to handle and is decidedly economical to operate. It weighs less than 400 pounds and the lifting weight with handles extended is only 100 pounds.

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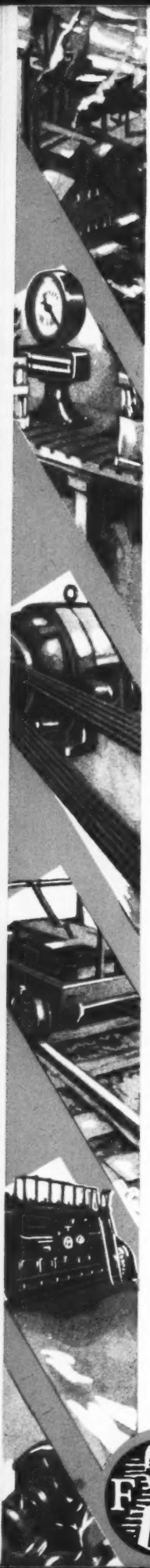
# FAIRBANKS-MORSE
## MOTOR CARS



# Compare the "Sheffield 44B" with other cars!

Men who have had experience with the "Sheffield 44B" will tell you that this is the best single-cylinder section car on the rails. They know how the "Sheffield" stands up under hard service. They know that this car can't be matched on low maintenance and long life.

The "Sheffield 44B" is *built* to deliver superior performance. It is strong enough to take hard knocks without a whimper. Yet strength is not secured at the sacrifice of fuel and oil economy. Here is a car that is a stranger to the repair shop. The clutch can't be burned out and both the engine and drive can be depended upon winter and summer in all kinds of weather.

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*Manufacturers of railway motor cars; hand cars; push cars; velocipedes; standpipes for water and oil; tank fixtures; stationary and marine oil engines; steam, power and centrifugal pumps; scales; motors and generators; complete coaling stations.*

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# FAIRBANKS-MORSE
## MOTOR CARS

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IN service Magor Dump Cars have thoroughly demonstrated the value of their exceptionally sturdy construction by giving extra years of trouble-free operation necessary for safe, economical and low maintenance dump car service.
The strong underframe—the well reinforced car body bed—the heavy doors all combine to give Magor Cars the stamina to stand up under the severe punishment of loading and unloading. Capacity loads of big rocks are handled safely and efficiently.

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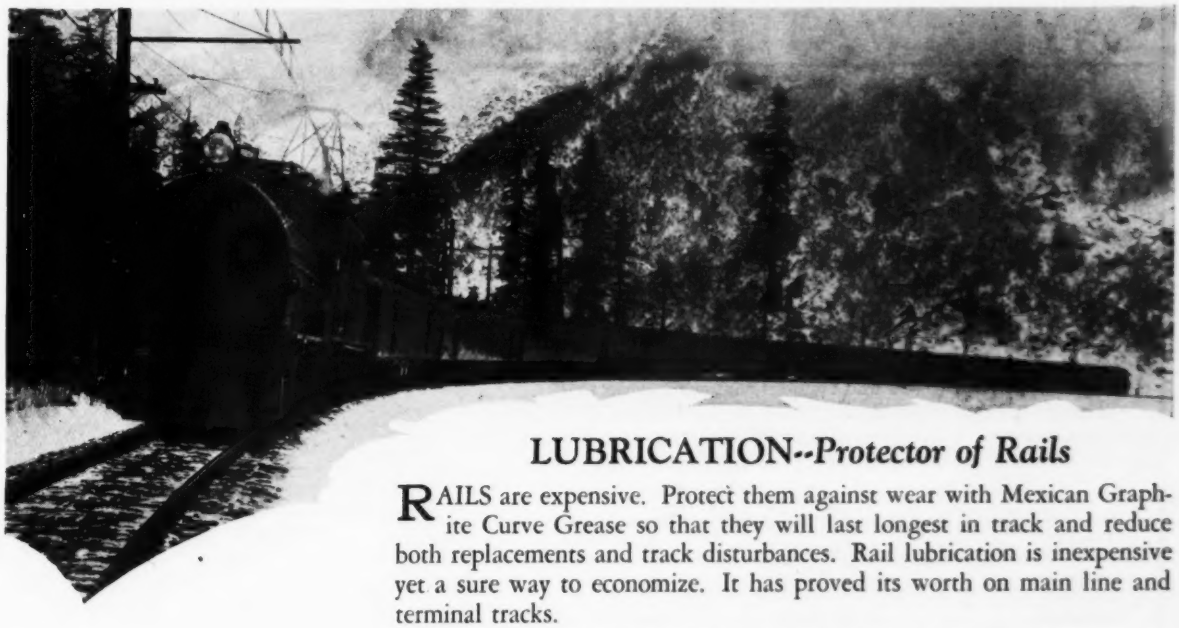

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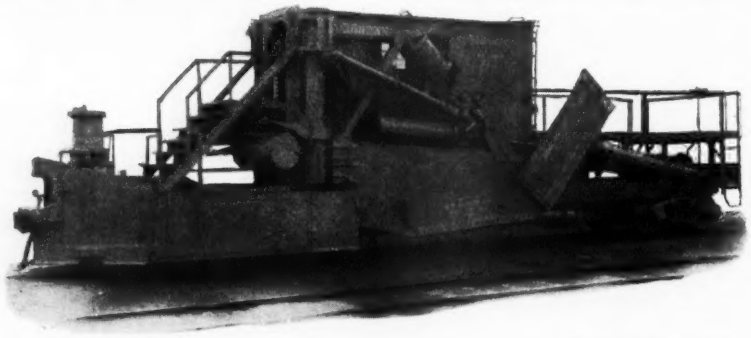
SAVES RAILS – REDUCES FLANGE WEAR



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Are Universal Material Handling Machines.
They will handle all materials within 24 feet of center of track and are limited only by the capacity of the motive power.
They can be used as Ditcher—Spreader—Snow Plow—Ballast Shaper—Ballast Plow—Roadbed Shaper.

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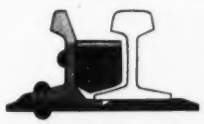

AT FOOT GUARD

The Bethlehem Hook-Flange Guard Rail is completely described in folder 202. Write for a copy.

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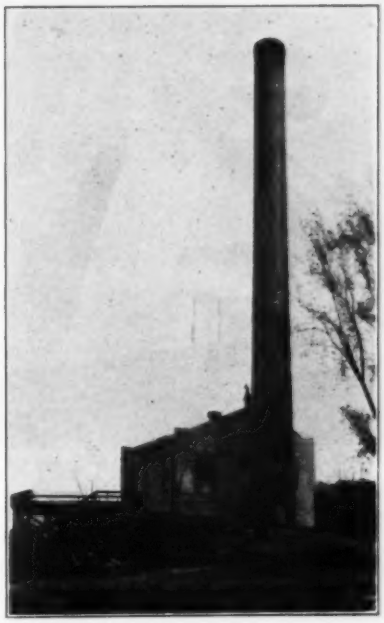
# BETHLEHEM
## Hook-Flange Guard Rail

PDM TANKS PITTSBURGH

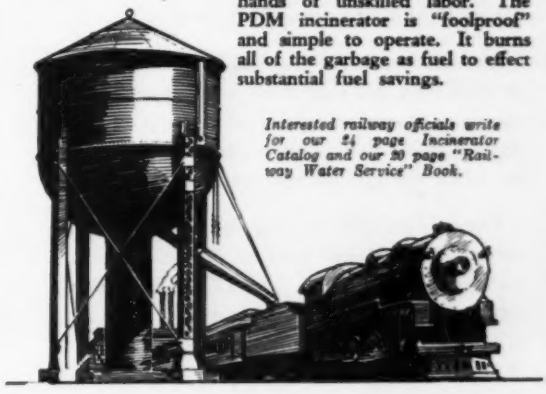
# RAILWAY INCINERATORS



This PDM Incinerator Plant at Wauwatosa, Wisconsin, has a daily capacity of 80 tons.

Food waste from dining cars and vegetable refuse from railway produce terminals today demand modern scientific destructor plants for rapid and odorless elimination of garbage.

The "Pittsburgh-Des Moines" plant has an enviable performance record in leading cities and large railway terminals. The operation of an incinerator is largely in the hands of unskilled labor. The PDM incinerator is "foolproof" and simple to operate. It burns all of the garbage as fuel to effect substantial fuel savings.



*Interested railway officials write for our 24 page Incinerator Catalog and our 20 page "Railway Water Service" Book.*

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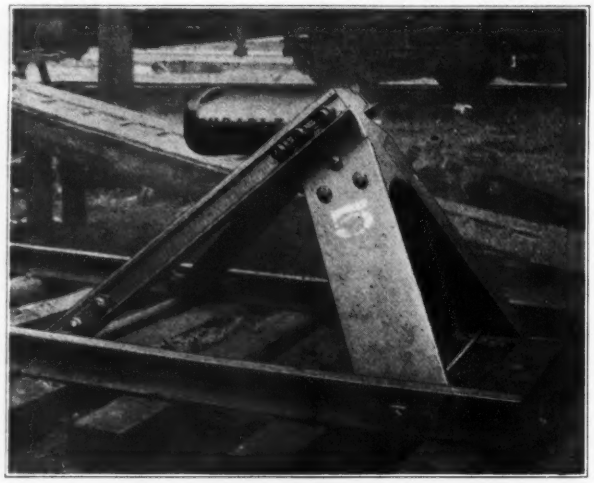

# THE DURABLE MODEL D

(Patented Aug. 3rd, 1920, Pat. No. 1348223, Other Patents Pending)

Like the other members of the DURABLE Bumping Post family, the Model "D" has massive, immovable strength that can always be depended upon to keep your cars on the rails —and in addition it can be used with equal success in freight or in passenger service.

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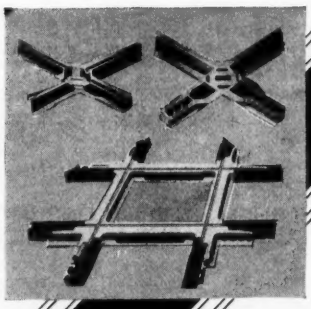

Patented July 6, 1926 No. 1591706

**William Wharton Jr. & Co.**
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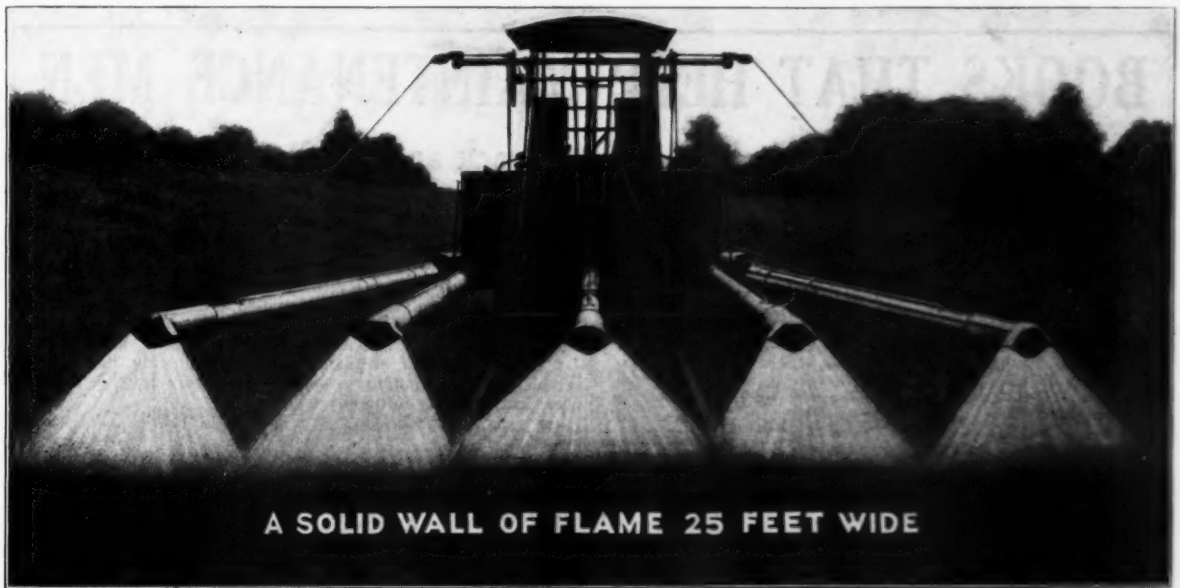

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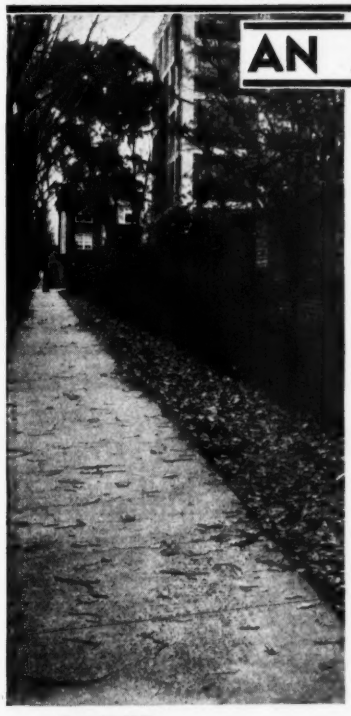

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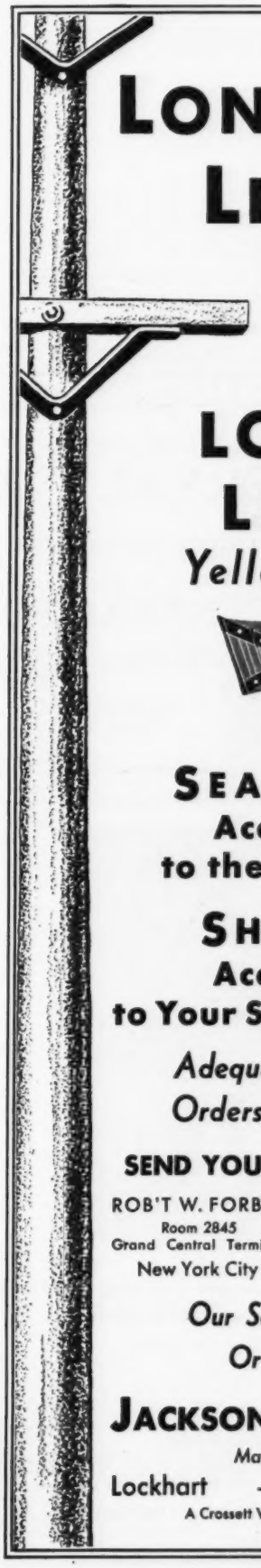

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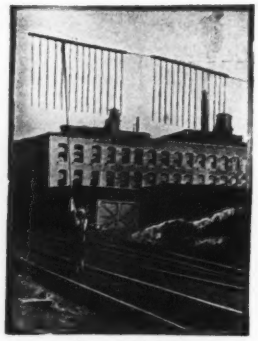

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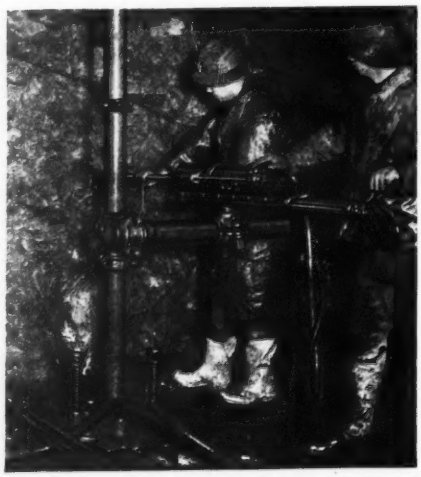

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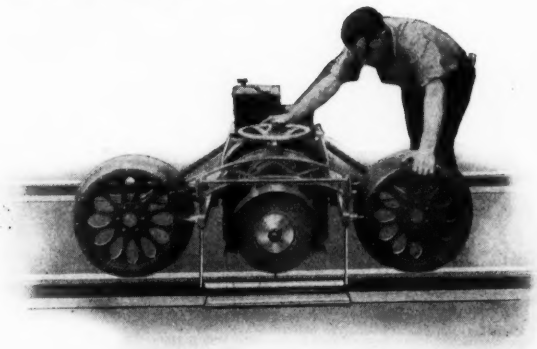
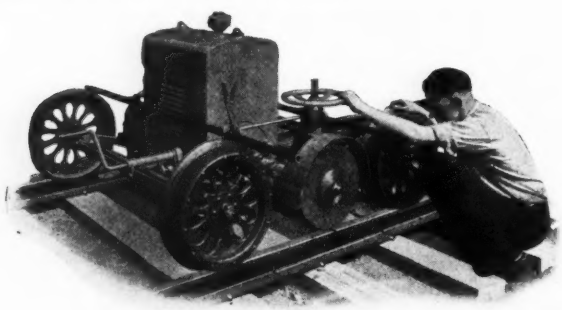


Model P-3



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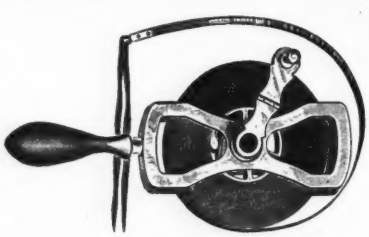

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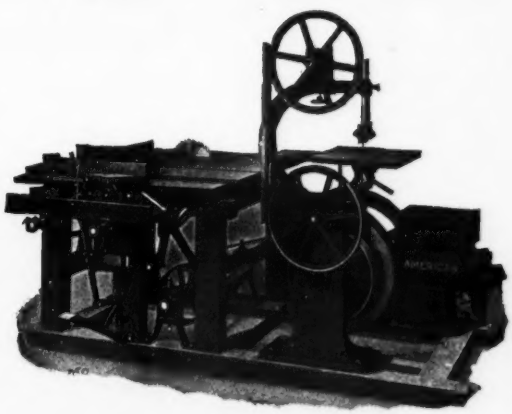

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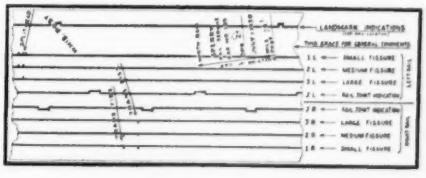
# SPERRY DETECTOR CARS.....

## ..tell the exact nature of defects before rail removal...

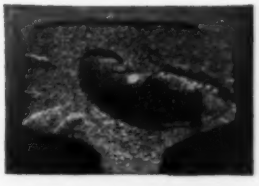


THE RECORD

THE PAINT MARK

THE HAND TEST

A TRANSVERSE FISSURE



A COMPOUND FISSURE

WHEN a Sperry Car passes a fissure in the rail, one-two or three-pen indications on the record tell whether the defect is small, medium or large. Simultaneously with the pen action, an automatic paint-gun marks the rail.

■ The operator immediately signals—stop—then reverse—and brings the car to a standstill at the rail mark showing the location of the defect. Here, to give the railroad detailed information as to how dangerous the rail really is, a hand test is made. Current is passed through the rail, and the operator locates the defect, exactly, with a highly sensitive instrument. The true nature of the defect is established and its correct size determined. If dangerous, traffic is stopped or a slow-order issued and the rail is removed immediately.

■ Scientific testing like this prevents transportation interruptions and property damage. No longer is it necessary to remove entire heats because of a few failures. Rails from any heat can be used until they become defective. Maintenance work is reduced and the expenditure for new rail lowered.

*For full details of Sperry Detector Car operation, write for a copy of Bulletin No. 57.*

SPERRY PRODUCTS INC.

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We Solicit Your Inspection,
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WOODINGS FORGE & TOOL CO.

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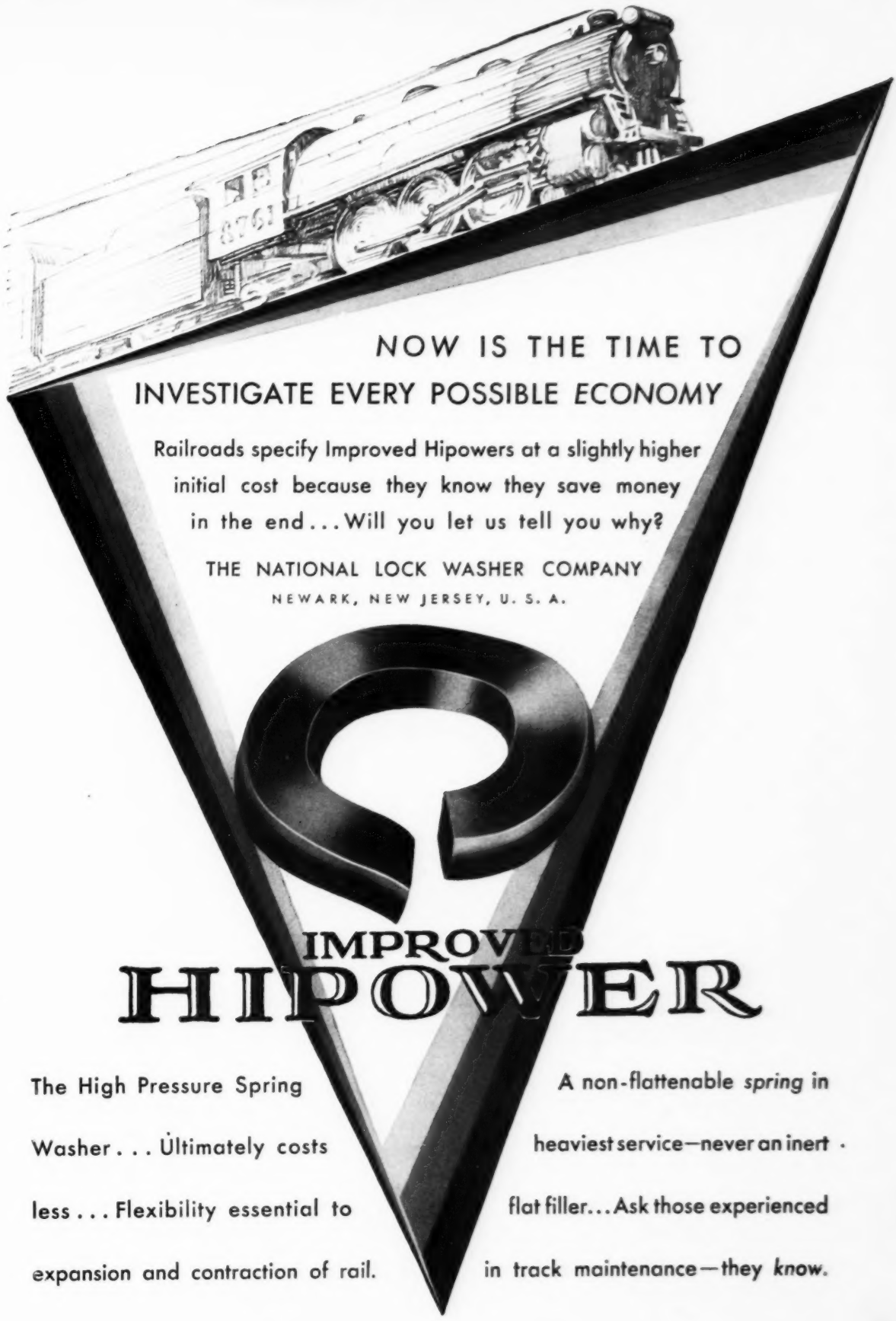
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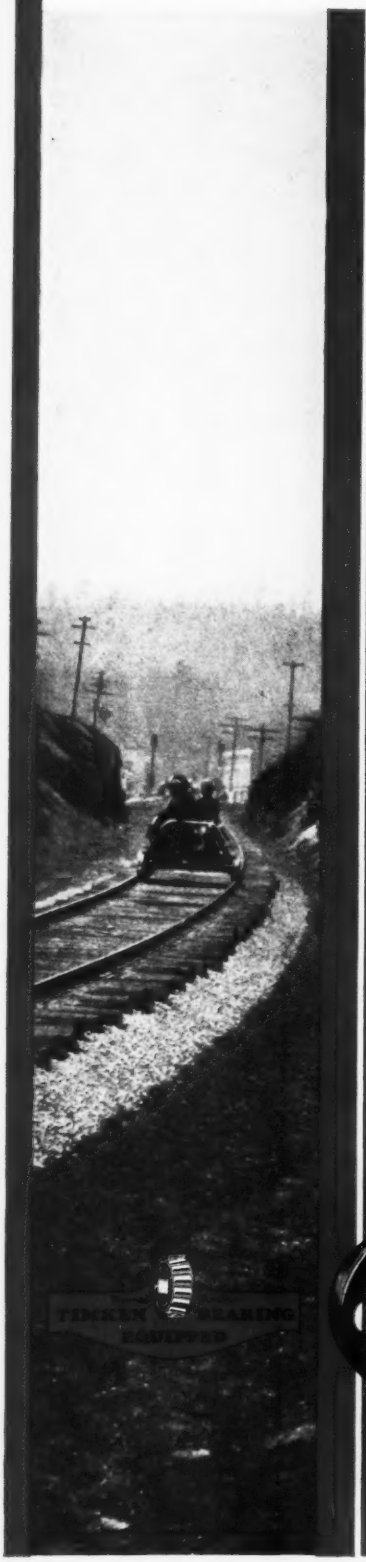
# Fairbanks-Morse "Sheffield" No. 46 section motor car has Timken Bearing Equipped wheels *and* engine crank shaft



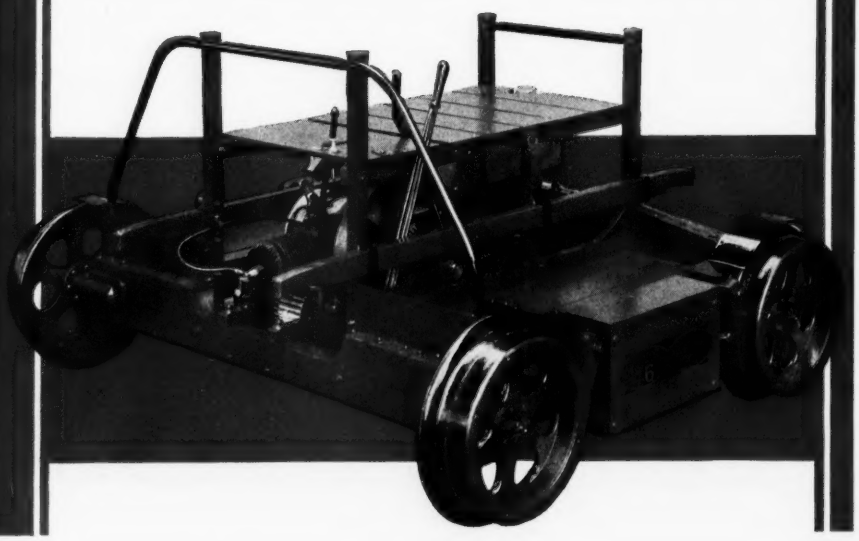
Light weight is stressed as an important feature of this section motor car, which is said to weigh less than 400 pounds.

To secure this desirable lightness without sacrificing strength and ruggedness was the problem the designers had to face. Its solution included Timken Bearing protection at the vital points.

Ten Timkens are used—two in each of the four axle boxes and two on the engine crank shaft.

Wheel stability is thus assured under all track and speed conditions. Radial, thrust and combined loads are surely and safely carried. Lubrication is a negligible factor. Hot boxes are avoided.

The mounting of the engine crank shaft on Timken Bearings is a modern practice followed by other leading gas engine builders. It protects the engine against vibration, holds the crankshaft in rigid alignment, protects it against uneven cylinder pressures and enables the engine to deliver maximum power.

Long life and low maintenance follow as a matter of course. The Timken Roller Bearing Company, Canton, Ohio.

**TIMKEN** *Tapered Roller* **BEARINGS**